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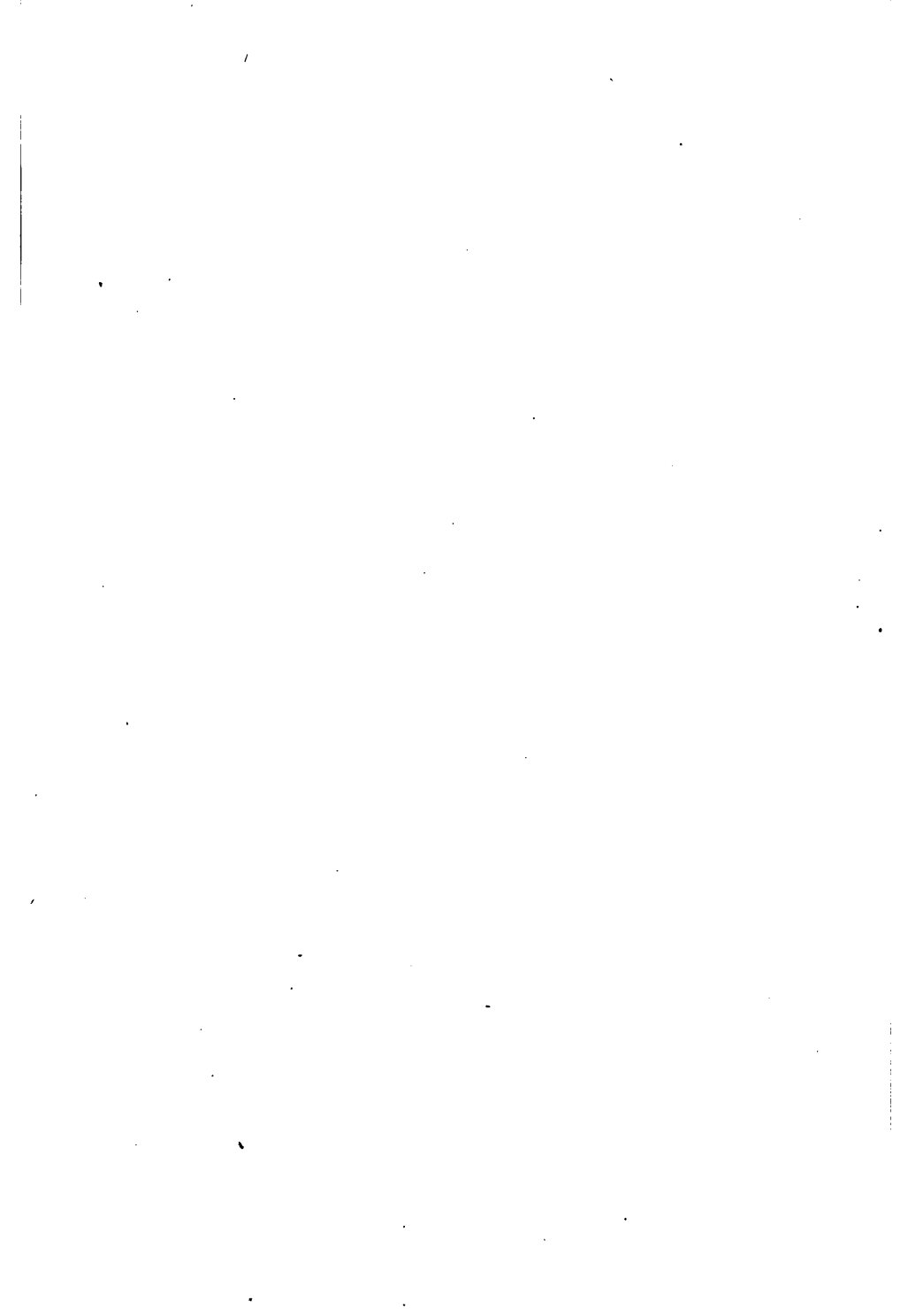


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Hydro-Electric Development in Ontario

E. B. BIGGAR





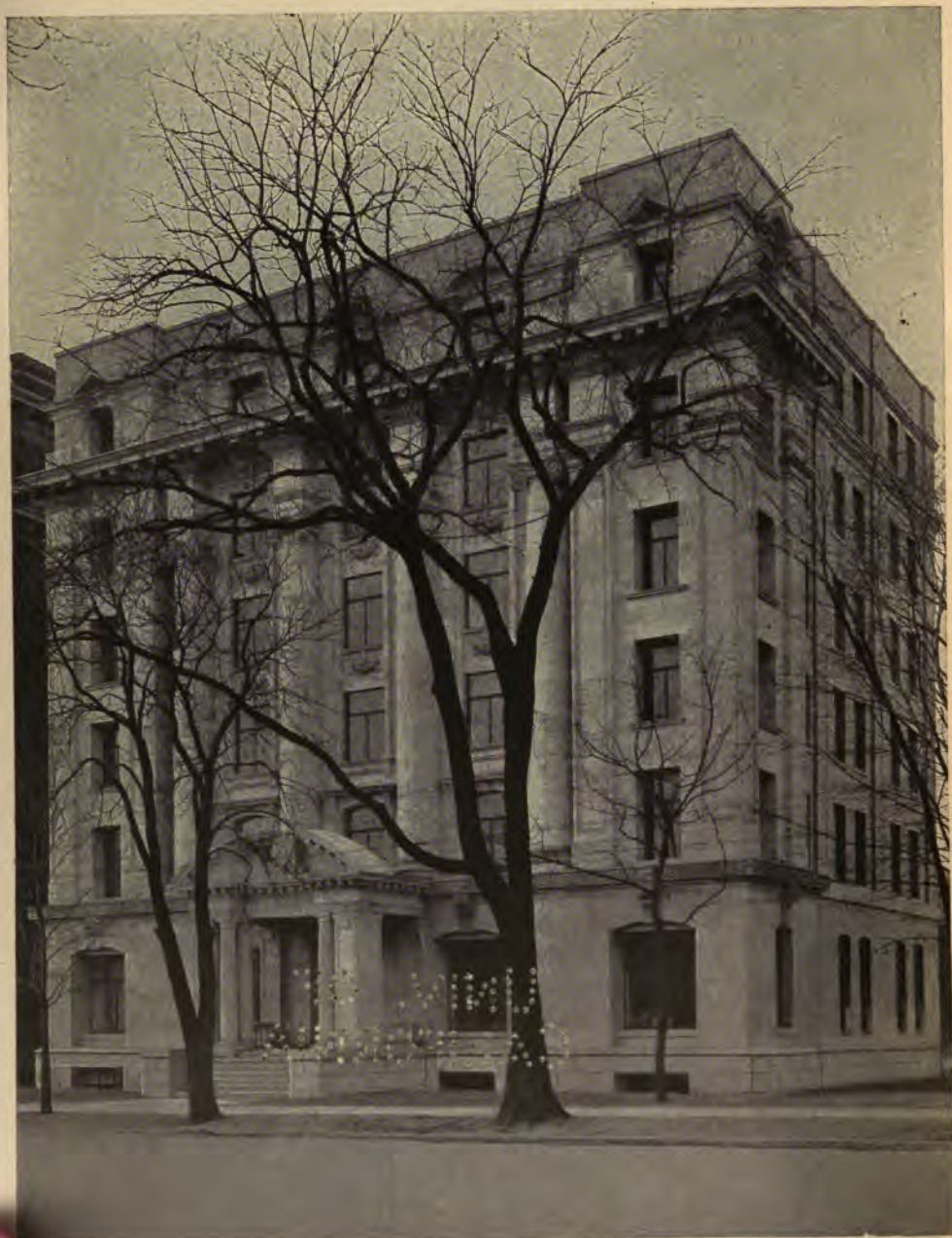




**HYDRO-ELECTRIC DEVELOPMENT
IN ONTARIO**



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Hydro-Electric Development in Ontario

A HISTORY OF WATER-POWER ADMINISTRATION
UNDER THE HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO

By

E. B. BIGGAR

Author of "Canadian Railway Problem,"
former Editor of Canadian Engineer, etc.

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PREFACE

The story of the Hydro-Electric Power Commission of Ontario should now be given to the world, if only because it has become the largest generator and distributor of electric energy in existence, and has already accomplished results worthy of a province whose hydraulic power resources are in some respects unique. To students of public affairs the record will be of peculiar value for another reason—that the principles upon which it has been evolved mark a new adventure in the field of economic legislation and because, among the municipalities comprised in the system, the co-operative plan of public ownership was developed in the face of the strongest body of private corporation interests ever arrayed against a public reform.

No one will claim that the working of the Commission has been perfect—if it had attained perfection from the start it would have been superhuman—but its achievements cannot now be questioned, and they challenge comparison with privately owned public-service corporations either on the ground of efficiency or economy of administration.

What of the future of the great water powers of Canada? What, especially, is to be done with the waters of the Niagara and the St. Lawrence? The plea for the preservation of the scenic beauty of Niagara Falls has for some years operated to check further diversions of water from the Falls for power purposes. Happily this plea has incidentally put a stop to the further exploitation of this power for private gain. But the Commission, in bringing cheap power and light to the communities in thousands of square miles of territory in Ontario, has created a new kind of vested interest in hydro-electric power—a vested interest which is the right and endowment of the humblest citizen and which aims at no advantage except the welfare of the whole people. This newly established public right, and the increasing cost of coal or other sources of energy

PREFACE

will impel the people of both Canada and the United States to draw more and more upon these and other waters to satisfy their daily needs. The present diversion of water at Niagara for power purposes could be doubled without seriously affecting the scenery of the Falls. But whatever the effect on the scenery, the day will come when the lower Niagara River will be turned into a gallery of power stations, serving the wants of a third of the population of the continent. The power of the St. Lawrence, too, will be harnessed to its full capacity; and then the rivers of the great north land will begin to do service for the millions of Canadians in a day not very distant, when the shores of James Bay and Hudson Bay will have become the summer resort of the continent.

Already three other provinces—Manitoba, Nova Scotia and New Brunswick, have followed the leadership of Ontario in creating power commissions. A short account of these will be found in the appendix. The state of New York is moving in an uphill fight in the same direction. In the United States at large, water power development under public protection has been stayed by the more or less conflicting action of the three federal departments—the Interior, Agriculture and War—among whom the control has heretofore been divided, but such conflict has been ended by the establishment of a Federal Power Commission composed of the secretary of each department, and a trial is being made of a system of water leases which will at least safeguard this great natural resource from further alienation. Hydro-electric power development will now proceed more rapidly over the whole continent, and in the coming era the crown of honor will surely be awarded to the little band of municipalities whose faithfulness to their ideals has implanted throughout America the conviction that the water powers are not to be local monopolies of private franchise holders but an estate held in trust for the whole people.

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CHAPTER I.

General Principles—Public Ownership of Public Services.

For several generations the main highways, the railways and, to a great extent, the canals of Great Britain, the United States and Canada have been under the control of private individuals and corporations. In extensive regions of these countries the ownership and administration of the chief channels of communication by private companies has been so long continued and complete that it has been accepted as the natural order of things, just as the motion of the earth or the moon is accepted as following from the laws of the universe.

Is this authority of a private person over the means of transport and other public services such as power and light a natural and ancient right or is it a modern trespass? The question can be answered with absolute certainty. The necessity of means of travel and the common right to those means is set forth clearly at the very beginning of the history of our race. To Adam and his descendants the command was given: "Replenish the earth and subdue it." The public right to the means of traffic is not merely implied but is imperatively required by this proclamation of the Creator. How could the world be colonized and the waste places replenished without a common right to move from place to place, and how could this migration continue without recognized rights of way? If it should be shown that no bar to migration existed in primitive times because there was then no private ownership of land, this would not in any way lessen the public right to the means of travel. It would in fact concede the public right to hold land and roads, for the one right would include the other.

It is remarkable that after the flood, when, by reason of

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the incurable wickedness of the ante-diluvian peoples, the slate was wiped clean and the race was given a new start under changed conditions, the same injunction to "replenish the earth and subdue it" was given, and in precisely the same terms. Thus was emphasis laid upon the first injunction.

The natural instincts of every ancient people must have urged them to fulfil this divine injunction, for if it had not been so we should have had no traces of those mysterious movements of nations of the remote past that have so puzzled students of ethnography. We know, moreover, that the Babylonians, Egyptians, Medo-Persians and other nations not to speak of the Romans, treated as a public right the primitive highways along which the King's proclamations and armies were sent.

The migration of the Israelites from Egypt to Palestine furnishes a striking specific sanction to the theory of the common right to the highway. As they approached the promised land the Israelites had to pass through territory occupied by the Amorites, and the sacred history states that Moses was required to ask from the Amorite King, Sihon, a right-of-way through his territory. We must infer that this request would not have been made by divine instruction, if it had been unjust, or contrary to common usage or natural right. Indeed the only ground of refusal likely to be taken was on the question of injury to property in passing, but Moses anticipated this by instructing his embassy to assure King Sihon that no injury would be done to property and that the Israelites would confine themselves to the high road. "We will go by the King's highway" is the expression as translated, and it is significant that the phrase "King's highway" occurs at this ancient date in such a connection as not merely to imply a public right acknowledged among the Amorites in their own government, but as clearly implies the admission of this right to the

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subjects of another ruler, the only condition being that of peaceful passage. Such a condition as private ownership of the highway could not have existed, or Moses would have recognized this by offering compensation to the owners which he did not do. So evident was this refusal of thoroughfare held to be a denial of a natural right that the advance was made by force of arms and this explains the annexation of Sihon's territory to the promised land.

As the Israelites continued their journey the same question arose in the case of Og, the King of Basan, with the same result. The inherent public right to the use of the road was assumed from the beginning to the end of these episodes.

Thus the fundamental conditions under which the world was to be peopled and its resources made to subserve the uses of mankind required that the means of migration and the channels of traffic should be a public right, publicly exercised. The logic of history is against the theory that the people's highways should be regarded as private property. That this function should be made the subject of private profit is therefore not founded on an ancient and natural right but on a modern perversion.

All nations, from those of remote antiquity down to that modern hermit people, the Thibetans, have recognized the need of a common right-of-way, but if this public right of communication had not been thus based on the instincts of the human race, the necessities of modern civilization would have called for its creation, owing to the advent of the railway and other mechanical means of transport. There is no need now to prove that the railway is the successor, in modern life, of the highway, for the service of the railway carries its own proof in the function it fulfils. The advent of steam and electric power and the development of the modern factory system involving the division of labor have made the railway at once a universal

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servant and a universal master. Railway freight rates, passenger rates and express rates are not commodities bought in a market by the citizen but taxes paid for a public service. These rates are none the less public taxes, because the railway may be operated by a private corporation, for that corporation can only act as a creature of the government, through the charter by which the government delegates its authority. Unlike many forms of taxation, the taxes known as railway rates are an inescapable burden, falling upon poor and rich, for there is not a single article that is bought or sold that does not owe to the railway or highway service some element of its cost or production. Proofs of this fact have been fully set out in another work, in which,* after various illustrations, the true relation of the railways to the people is stated in the form of five main propositions substantially as follows:

First—The railways of a country are the main highways of a country.

Second—There is no source of railway revenue other than the rates imposed upon the people for the carrying of their persons and their goods.

Third—This revenue is raised, not from any hidden fountain of wealth within the railway itself, but from the earnings of the people whose labor and money furnish the traffic.

Fourth—By the division of labor in modern civilized life, everyone who earns or spends money contributes directly or indirectly to the cost of transportation, and this cost enters into every article used by every citizen.

Fifth—A nation's means of communication is a function of sovereignty, and since all the people contribute to their cost, railway rates are a national tax, and when traced to their ultimate effects are found to be the largest element of all forms of taxation.

* "The Canadian Railway Problem." Macmillan & Co., Toronto.

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Now it follows logically from the last proposition that when a state delegates this power of taxation to a private company and that company exercises this sovereign power for its own profit in operation those profits become a tax upon a tax. With only this difference, that the one taxing power is held by a joint stock company and the other was usually held by an individual, the system is precisely that which was permitted in the declining years of the Roman empire, when the customs and other revenues were raised through authority delegated to men known as "publicani" who made their wealth by the surplus they were allowed to take from the people over and above the tribute required by the government. The publican merely anticipated the policy of the modern transportation franchise holder of levying in rates "all that the traffic would bear."

The fact that electricity, coupled with hydraulic power has become essential in transportation, lighting and other common functions, brings this new power under the same rule of public right.

The principle of self-government in the transportation service and in those services such as public lighting, the supply of power, water and other requirements that govern modern community life, is vital, not only because without the satisfaction of these needs such community life could not exist, but because the cost of maintaining them has become the most searching and inexorable of all forms of taxation. The inquisitions of the income tax officer may be circumvented, the customs duties may be evaded, the inland revenue collector may be avoided, but the direct and indirect levies of the railway, highway, steamship and other public services fall alike on youth and age, wealth and poverty, on the citizen of the metropolis and the hermit settler in the remotest woods. The tax is taken in a thousand forms, most of them without the cognizance

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of the tax payer, and never once need he be confronted by a customs officer or income tax assessor, but through the self-inquisition of his own daily needs. Indeed he may never have personally paid a freight bill or bought a railway ticket.

It is a fundamental principle of representative government that the people who pay the taxes shall control the disposition of those taxes. "No taxation without representation," and "millions for defense—not one cent for tribute" were the demands that had their issue in the American revolution; but, while maintained in form, the principle was abandoned in practice when the modern highways were given over to private corporations to be operated for private profit.

The "farming out" system on the highways of England began in 1663, when the counties of Hereford, Cambridge and Huntingdon were permitted by act of parliament to levy tolls for the maintenance of the trunk roads, and the turnpike trusts, thus permitted, developed into such powerful corporations that when the era of steam railways began these companies were able to extend to the railway systems the monopolies they had held over the turnpikes. That the turnpike trusts were organized primarily for profit to the shareholders may be inferred from the estimate made by Adam Smith, author of the "Wealth of Nations," that the tolls levied at the gates of the turnpike trusts were more than double the sums needed to maintain the roads in repair. The methods by which their successors, the railway corporations, not content with the profits of railway operation, exploited the great natural resources of the country such as coal and other mineral lands, forests and agricultural lands to their own enrichment, gives ground for the charge that the surrender into private hands, for private profit, of that which is by its nature a function of the sovereign state has been the source of grave corruption of public life in the past. That which has been said of the power of song might

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be paraphrased in the realm of politics: "Let me own a country's railways and I care not who makes its laws."

Yet the aim of public law is righteousness and these ancient rights are being revindicated. The postal service, which in its nature is similar to that of the railway and express, was once under private control in Europe and Asia but is now under state operation in every country in the world. The post office, was always expensive and inefficient under private ownership, and it never became cheap and universally serviceable till it was brought under state control and operation. The history of the postal service is being repeated throughout the world in the railway, and other services which by their nature govern community life. Starting with the single Kingdom of Belgium—which at the very outset of its railway building, recognized the transport service as a matter of public concern,—the theory of public ownership has been applied in practice in one country after another, under all forms of government, until at the outbreak of the European war Great Britain, the United States and Canada were the only countries of importance where the majority of the railways were under private ownership. The events of the war demonstrated in hard practice, what ought to have been evident in simple logic, that the railway service is a unity in its nature performing the one function to the whole nation and to every class within it. That the duplication of lines to the same centres was a waste of material, labor and land was equally demonstrated; and the whole theory of "competition" under private ownership was shattered beyond recovery on the field of war.

The deduction from this history is that the public control of public functions is not a matter of expediency but a matter of right and duty, and the obligation to public control will not be affected in the least if it could be shown that private ownership is more efficient than public. The failure or weakness

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of one administration is not a reason for abandoning the principle of self-government but rather for the reform of the civil service or methods of operation. If anything goes wrong in our post office we do not dream of handing back to three or four private companies the control of our means of intelligence, but we demand new men and better methods.

Advocates of the private ownership of a public function imagine that the people's rights are to be secured through competition among private corporations. This is a fallacy that obtained wide acceptance in the first railway era when the railway companies, by duplicating and triplicating the lines to the chief centres of traffic were seeking a share of those revenues drawn in every case from the community at large. Rates often were lowered while the companies were extending their reach, but as soon as they attained their aims, then their wider object of maintaining the tolls was sought in amalgamating the local systems with which they had connections.

George Stephenson, whose grasp of railway economics was equal to his knowledge of railway engineering problems, thus stated the principle: "Where combination is possible competition is impossible."

As before shown, the railway serves the same purpose to the entire community and to each individual in the community. It is therefore a unity in itself, and unity cannot be maintained by disjunction or competition.

That competition, as exemplified in the multiplication of railways between the same cities in Canada, has lessened the cost of transportation to the Canadian people is an illusion that has now been dispelled. The second and third lines between Toronto and Montreal for example, have cost the country over \$60,000,000 besides the annual maintenance and operating cost of \$3,500,000 to \$5,000,000, and the waste of land, labor, etc., on the three rights-of-way. Instead of bringing a reduction

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of rates, which was the proposed object, the triplication of lines, by a tacit agreement between the "competitors," has actually been followed by increases. Meantime an area of land in Ontario as big as several European states still remains a desert because of the lack of the 850 miles of track devoted to this illusory "competition." The region will remain a desert till electric railways open it up. It is calculated that the money thus spent on these steam lines would have paid for all the electric lines at present proposed by the Hydro-Electric Power Commission (\$51,870,000) leaving several million dollars to the good, and that the annual cost of maintenance and operation of these steam roads is nearly double the interest on the bonds that would be issued for the radial lines.

From the principles set forth it should not be inferred that those who invested money in public service companies did anything more reprehensible than those who bought shares in factories or mines. They found the private control of state services, or community rights, in existence and therefore took it to be right. The primary wrong is, therefore, not with the investors, but with the system which in the past two centuries has tended to give semblance of right to the claim that the public service itself is a private prerogative. If a delegated privilege of collecting taxes can be construed into a claim for good-will, or an inheritance in favor of the tax collectors, then government by the people and for the people is only the shadow of a lost power.

CHAPTER II.

The Power Resources of Canada and the United States.

To understand what is in store for Ontario in the conversion of falling water into power, it will be well to survey this province in its relation to the rest of the Dominion and to the United States, and to know the relation of hydraulic energy to coal and the other chief sources of primary power in both countries.

If a person could mount high enough in an aeroplane and possessed a range of vision sufficient to see the whole continent at a glance, he would observe some remarkable contrasts in the two divisions of North America. From the boundary line looking over the United States, one would see that in the Rocky Mountain and Pacific Slope States where water power is most abundant the population and the coal deposits are relatively least. The same is true of the White Mountain and Adirondack Mountain districts of the Eastern states, and in a modified way of the Appalachian mountain regions of the south-east. In striking contrast to this, one finds the densest population and the greatest congregation of industries in those great central and eastern areas, most devoid of water power but most bountifully endowed with deposits of anthracite and bituminous coal, and of power-producing mineral oils. Almost the only exception to this statement is the vast power source of Niagara Falls, described in other chapters.

Turning the eye north to Canada we see the above conditions almost completely reversed. The Atlantic seaboard province of Nova Scotia has bituminous coal areas aggregating nearly 11,000,000,000 tons, with undeveloped water powers of but little

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over 100,000 h.p. New Brunswick has 166,000,000 tons of bituminous coal—with beds of oil shale as yet undetermined—and about 300,000 hydraulic horsepower. Beyond the prairie regions and extending from the United States boundary to the Arctic Islands of Canada along the Rockies and the Pacific Slope, there are coal beds officially estimated at 1,346,658,400,000 tons of which 845,900,000 tons are semi-anthracite and about 1,000,000,000,000 tons lignite and sub-bituminous, the rest being bituminous. There is here an exception to the rule, inasmuch as British Columbia, Alberta and the Yukon have over 3,500,000 h.p., of undeveloped hydraulic energy, in addition to their colossal coal deposits.

But what a contrast do we find in the provinces of Central Canada. In Quebec there is neither coal nor mineral oil for power production. In Ontario there are small and diminishing quantities of natural gas and mineral oil. Traces of low grade lignite have been found in Northern Ontario, and there have been unverified reports of coal in the islets of Hudson Bay, but there is no evidence of commercially usable coal in this province. To these two provinces, however, a marvelous and providential compensation has been given in the hydro-electric energy, more precious than coal and all other forms of primary power combined except for the one purpose of heating.* Ontario and Quebec contain more than half the population and five-sixths of the manufactures of the Dominion. Of the total endowment of water power in Canada of about 20,000,000 h.p., Ontario and Quebec inherit about 12,000,000 undeveloped horse-power or three-fifths of the whole; and the distribution of it is remarkable. From the termination of the prairie land in Manitoba there rises the great Laurentian chain of mountains, extending

* See Hydro-Electric Power Commission's bulletin on "Heating of Houses—coal and electricity compared." Also bulletin No. 6 under same title, prepared for the Hon. Council for Scientific and Industrial Research, by A. S. L. Barnes.

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eastward to the shores of Labrador, and forming a "great square of Pegasus," more than 1500 miles from west to east, and 1000 miles from north to south. Stating it broadly, these ridges have a backbone which fairly evenly parallels the shores of Hudson and James Bays on the north, and Lake Ontario and the great St. Lawrence on the south, with an elevation of one to two thousand feet above the sea. Hence the many rivers and streams flowing north and south from these heights give a hydraulic situation without equal in the world, either as to the volume of power or its availability for the service of the people. At present there is a far greater density of population in the southern portions of these provinces, but if the present colonization movement continues it may not be many years before the power awaiting to be developed in Northern Ontario and Quebec will sustain more people and their industries than now exist in the southern sections. It would be astonishing if this were not the case, judging by what is happening in the mountain states, and by what has already been accomplished by the Hydro-Electric Commission, as we shall see later on. What the late T. C. Keefer, one of Canada's ablest engineers, said of Canada at large may be applied especially to Ontario:—

"There is an almost continuous distribution of lakes, lakelets and rivers; the lakes of various outlines, dimensions and elevations from the sea, and many possessing facilities for the storage of their flood waters. In many places the outlet from the lake or chain of lakes is a narrow cleft in the rock where an inexpensive dam will hold back the water supplied by the winter's accumulation of snow."

Mr. H. G. Acres in a monograph on this subject,* expresses the opinion that "practically all industrial and commercial centres in the Dominion, from coast to coast, have

* "Water Powers of Canada—The Province of Ontario." By H. G. Acres, Hydraulic Engineer, Hydro-Electric Power Commission of Ontario.

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sufficient potential water power within easy transmission radius and of sufficient capacity to meet all anticipated requirements."

A revolutionary change is already being wrought in the process of colonization in Ontario by the electrical transmission of water power. The settlements during the first half of last century followed the channels of the rivers and the lake routes, and these were modified by the routes of the railways built in the last half of the century; but now the water powers of Ontario, utilized as an element of public policy, are carrying forward agriculture, mining and industrial developments, including electro-metallurgical and electro-chemical industries in leaps that will bridge hundreds of miles of wilderness at a bound, drawing the electric railways after them as bridges for further progress. In this era of power development it is quite possible to apply great blocks of power near the site of the power houses at the lowest rates attainable in order to smelt ores, refine metals, produce chemicals and their compounds on such a scale as to furnish materials and feed the industries of the whole province or even aid in exports as has been done at Niagara Falls. Such a control of power would afford stability to industries in general, by having within the provincial borders the assurance of an uninterrupted source of supply for the essential chemicals and metals.

Mr. Cecil B. Smith, another distinguished Canadian engineer, pointed out one important advantage in the power supply of these regions in the storage of water by winter's snow, which often defers the period of minimum flow till the time of the autumn rains. Since the efficiency of a stream is determined by its minimum flow, nature here comes to our aid in the climate by reducing the difference between the maximum and minimum flow.

Remembering that the actual present developments have so greatly outpaced the calculations of many experienced engin-

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eers, advances predicated on these natural resources are surely within sight of the present generation. The Hydro-Electric Power Commission of Ontario whose history will be reviewed in this work, began with the delivery of 750 horse power in August, 1910, none of which it generated; now it is distributing over 315,000 h.p. and when its generating plants on the Niagara and other rivers are in operation in 1921 it will have 750,000 h.p. for public use—that is to say one thousand times its initial output. The total hydraulic energy of Ontario is variously ~~estimated at 5,000,000 to 6,000,000 h.p. or nearly nine times the power now developed,~~ but this takes no account of the increased efficiency from storage dams or the better use of some of the present uneconomical plants. Basing conclusions on the opinions of such engineers as T. C. Keefer and Cecil B. Smith, the potential powers of Ontario are greater than present estimates. A number of the rivers and streams flowing into James and Hudson Bays have never been explored and consequently their powers remain unmeasured. That investigations will disclose more power will be apparent from the three situations on the St. Lawrence, the Ottawa and the Georgian Bay waterways. At the Long Sault Rapids and near Morrisburg on the St. Lawrence, referred to elsewhere, a million horse power may be developed for Ontario and another million for the state of New York. Investigations have not been thorough in regard to the upper Ottawa and Georgian Bay region, but when a private company approached the Laurier Government a few years ago for a charter to canalize the upper Ottawa to connect the upper lakes with the St. Lawrence they stated that a million horse power would be available as an incident to the public advantage of the navigation channel. This estimate was subsequently confirmed by a government engineer. The late Cecil B. Smith estimated from a government report on the French River improvements which were

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part of the scheme, that the power revenue would be sufficient to cover the interest on the canal expenditures which had been placed at \$150,000,000.

As stated, the power possibilities of the great north land sloping to James and Hudson Bays have only been partially explored and the mineral resources of that region are even less known, but the fact that the greatest nickel mines of the world and the greatest cobalt-silver mines of the world were disclosed in this region as the result of excavations for railways will justify the expectation of further disclosures, when these latent resources are turned into public service.

At the last meeting of the British Association for the advancement of science, the President, Sir Charles A. Parsons, the inventor of the steam turbine, referring to the influence of cheap water power said: "At some time more or less remote—long before the exhaustion of our coal—the population will gradually migrate to those countries where the natural sources of energy are most abundant."

Reviewing one aspect of the Hydro-Electric policy, it may be conceded that if no attempt had been made to extend to the general public the advantages of the large water powers such a place as Niagara Falls might to-day have been a large centre of chemical and other industries, but the Hydro-Electric Power Commission has been the means of bringing the blessing of nature's coal-saving and power-increasing resource to hundreds of communities whose industries react beneficially on the farming communities of the whole area reached. These numerous cities, towns and villages now constitute the greatest and most diversified industrial area in the Dominion, and there can be no question that if this cheap power were withdrawn these manifold industries would be paralyzed. The industrial situation may be concentrated into one significant fact that from the high rates of steam-raised power—\$40 to \$60 per h.p.—

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the average cost of power in the Commission's territory has been reduced to \$18 per h.p. per year, or less than half that of any State in the American Union east of the Pacific Slope. The comparison, it will be noted, is with those American States of the mid-continent and the east where coal is cheapest and industrial development has been greatest.

The tendency to increase the price of coal and the probability that the anthracite mines of the United States may be exhausted in fifty years will raise the question of Canada's predicament, if that country restricts or prohibits the export of coal. Attention was called to this problem in 1910 by Mr. Arthur V. White,* consulting engineer to the Commission of Conservation, who suggested an exchange of electric power for coal, if Canada were pressed in this matter. It is obvious, however, that if Canada uses her own coal even though deprived of anthracite, she will retain her economic independence and avoid a heavy annual financial drain. Canada consumes about 35,000,000 tons a year, but as she produces only about 15,000,000 tons there is an import bill for about 20,000,000 tons. Practically all of this outlay could be saved if the state owned or controlled the mines and railway rates were revised to equalize the price in central Canada. Every horse power of hydro-electric energy developed saves many times its cost in coal. It is not as easy as it seems at first thought to determine what the difference is in practice between steam-raised and hydro-electric power. There are comparatively few engines that give the highest attainable efficiency, which is about 6 tons of coal for each horse power per year. With inefficient engines or engines operating only 8 or 10 hours a day, the cost may run up to 50 tons per horse power per year; so that 20 to 30 tons per year may represent the average present cost in Canada. The consumption in Canadian locomotives alone varies from 9,000,000

* University Magazine, Oct., 1910.

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to 12,000,000 tons a year, and hauling coal monopolizes one-third of the freight of Canadian railways. Making allowance for the need of coal for heating, the electrification of Canadian lines would turn this annual drain of money into a source of current revenue from the development of the Canadian mining industry. To use coal for the generation of electricity, however, is in the first place to use up the country's capital resources, and in the second to tax its transportation capacity; whereas waterpower once installed is the one natural resource that is not diminished by use but replaces itself by the inexhaustible bounty of the heavens. In a recent statement Mr. Franklin K. Lane, U.S. Secretary of the Interior, said: "Water power can do more than any one thing to lower the cost and raise the standard of living; it is the root of agricultural wealth; it is the key to the industrial life of the future, and it is essential to our national defense. The policy of the government towards water power affects the welfare of every man, woman and child."

These convictions were no doubt based on observations of developments in the United States, and these developments are of the highest interest as an index to power developments in Canada. A report made to the Department of Agriculture in 1916 on "Electrical Power Developments in the United States" showed that of a total of 30,448,000 h.p. for all primary purposes in 1912, 80% was still raised by steam, water power representing 4,870,000 h.p. While water power development increased from 1902 to 1912 by 98%, in the whole country the increase in the Mountain and Pacific States was 451% or over four and a half times as much as in all the other states combined. It is noteworthy that 120 privately owned corporations claim to own four-fifths of the water powers now used in public service operations, on which the report comments: "The investigation shows a marked tendency towards association or community of interests, particularly between the principal holding companies, that can-

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not be viewed without concern." While the rate of increase in steam-raised power from 1902 to 1912 was 96%, that from water power was 137%.

Attention is drawn to the fact that "no other state has had such remarkable water power development as California within the last few years." Hundreds of thousands of horse power have been developed and hundreds of millions have been invested in the electrical power business. Yet a most careful investigation could not discover that a single new public utility enterprise involving the development of water power had been started in that state in the last six years. The remarkable development which has taken place consists entirely in extensions to the business of concerns already in the field * * * * The determining factors will be the control of the market and the control of the sources of credit. Hence the report shows the significance of the fact that directors and officers in banks are also directors and officers in the electric power holding companies. The investigators see a dead-lock between the public and private interests, and suggest the creation of a common carrier system of distribution under public control, a step which would reduce by one half the interest rate now demanded of electrical development projects. These facts will be impressive to those Canadians who imagined that the idea of competition would have had any influence on a group of private capitalists who had already secured a monopoly of power as at Niagara Falls and other points. This gives us the measure of the public service already rendered by the Hydro-Electric Power Commission.

By comparison Canada is richer in coal resources than the United States. The reserves of the latter country within 3000 ft. of the surface are estimated at 4,231,352,000,000 tons, or one-half those of the whole world; while those of Canada are 1,360,535,000,000 tons. These are nearly a third of the United States' supplies whereas the population of Canada is about one-

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tenth that of the United States. The coals of the Canadian Rocky Mountain region, "as regards both quality and quantity, constitute probably one of the most valuable deposits in the world."*

If we assume that half the coal imported will still be used for heating purposes, the saving on the imports of coal that would be effected if all the 6,000,000 h.p. of hydro-electric energy available in Ontario were developed would be 60,000,000 tons, which at \$10 a ton would amount to \$600,000,000 a year.

A report just issued by the Department of the Interior, under the direction of Mr. J. B. Challies, Water Power Branch, indicates the rapid transformation already made in the use of hydro-electric power. In 1918 the total primary power installed in the central stations of Canada was 1,844,571 h.p. of which 180,200 h.p. was generated by steam, 11,710 by gas and oil engines, while 1,652,661 h.p. or nearly 90% of the whole was generated by water power. Ontario alone generates 95.7% of all its power from water. On this Mr. Challies remarks: "The percentage of primary power in central stations produced from water is extraordinarily high, and is indicative of two outstanding features, *viz.*:—the extent and availability of the water power resources of the Dominion, and the remarkable degree to which their adaptability for central station work has been appreciated in principle and realized in practice." The Dominion has already 276 developed horse power per thousand inhabitants—a ratio exceeding that of any country in the world except Norway.

Electrical engineers are confident that in long distance transmission pressures can be increased from 110,000 volts to 220,000 or 250,000 volts which would enable generating stations on or near the Laurentian "divide" to transmit electrical power to the southernmost confines of Ontario.

* Cecil B. Smith.

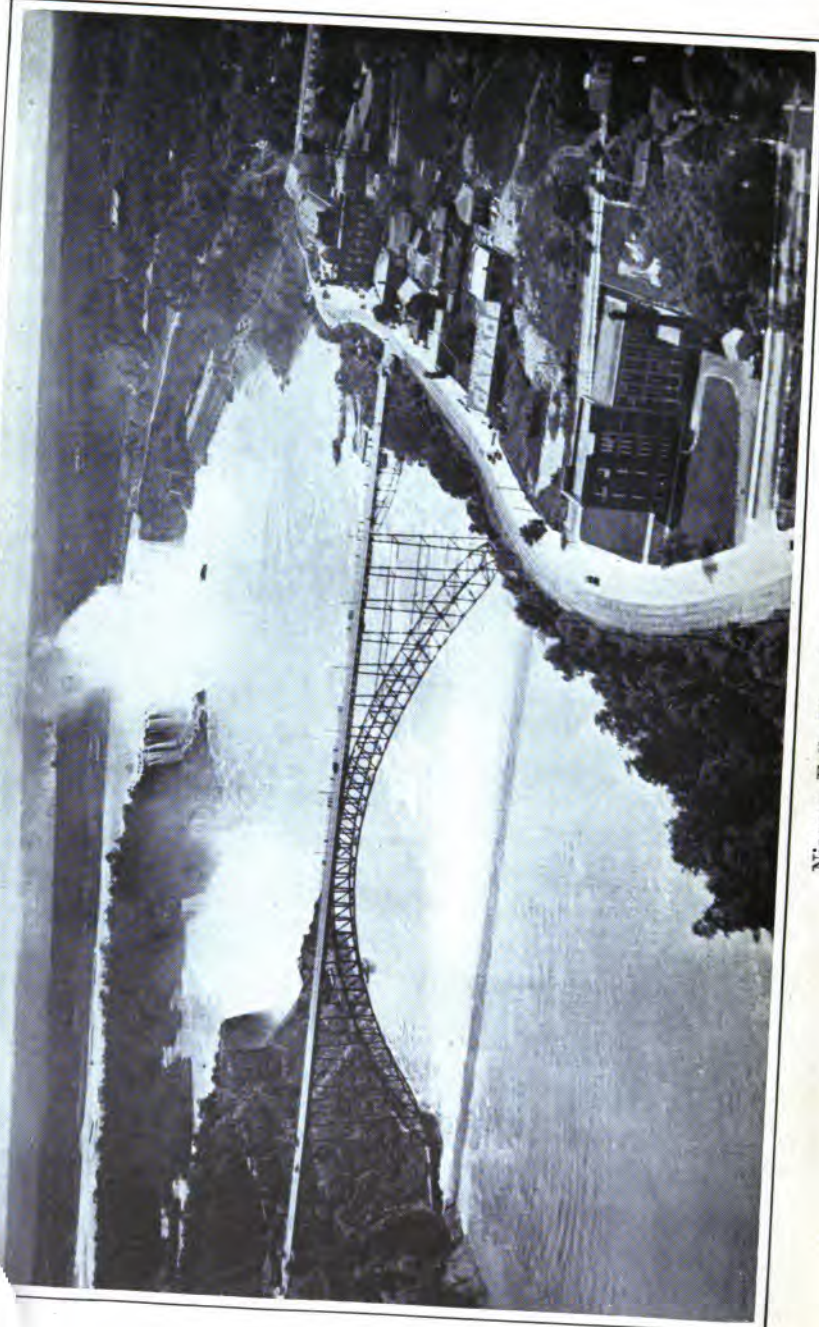
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In concluding this survey of the prospect of Ontario's power developments, it may be said that the Power Commission has provided the foundation upon which the municipalities of Ontario may build up not merely the form, but the reality of self-government in the conduct of their public services, and that its evolution has opened for the whole world a new vista in the administration of public utilities. Every year since the pioneer municipalities pledged their faith in the statesmanship of the plan, there has been a steady and sometimes an embarrassing increase in the number of city, town, village, county and township councils that have come into communion with the new organization, in the supply of light and power.

Under the control of the Hydro-Electric Power Commission of Ontario each municipality may furnish power and light to its citizens at rates as low as feasible, provided these rates cover the cost and do not discriminate against individuals or against neighboring municipalities; and these rates can never be taken out of their own control, nor will it be in the power of a private company to make capital out of a community's own growth.



The Horseshoe Falls at Niagara, Illuminated by the Hydro-Electric Power Commission of Ontario.



Niagara Falls Viewed from the Air.

CHAPTER III.

Eighth Wonder of the World Revealed at Niagara.

In the closing years of the nineteenth century engineers were groping their way towards a comprehension of the possibilities of long distance transmission of the electric current for power, lighting and other kinds of service to the community. Nowhere in America was the progress of electrical engineering followed more keenly than in central Canada, for the reasons outlined in the last chapter.

Happily the electrical engineers who were then teaching the people the enlarging uses of electricity were not thwarted by those in the seats of the mighty, as was the case in the infancy of the steam railway, but found willing colleagues among provincial legislators and leaders in commercial life. When it had been demonstrated that power and light could be transmitted from Niagara Falls to Buffalo the possibility of transmitting to Toronto and other Ontario cities became of general interest, especially while the sufferings of the people from the effects of the Pennsylvania coal strike of the autumn of 1902 were still fresh in mind. The lesson of this strike was all the plainer, from the standpoint of the public interest, since it was a private railway corporation that withheld the coal at mines in the middle of winter, when it was most needed, and it was the private railway corporations that failed to distribute the coal already mined. Coal which in 1901 was sold to consumers in Toronto at less than \$5 a ton (the city of Toronto had bought its supply at \$3.68) could now be had with difficulty at \$10 to \$15 a ton, and Toronto and other Canadian cities for the first time were obliged to import two ship loads of Welsh coal at an average of \$10 a ton to keep the citizens from perishing. This

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crisis first directed general attention to the fuel and power problem of Ontario, and the failure to discover any areas of either bituminous or anthracite coal in Ontario or Quebec has made the problem of increasing interest since then, because of the rise in the permanent level of coal prices.

It was to be expected, therefore, that the beginnings of long distance transmission of electric power should concern the people of Ontario very seriously. If the power of the Niagara River could be fully used and distributed this source alone would replace all the coal then used for driving the machinery and lighting the homes of all the citizens, with vast amounts to spare for helping the work of the farms. Between Lakes Erie and Ontario there is a difference in level of 326 ft. at mean stages of water, and the volume of water flowing down the Niagara averages 210,000 cubic feet per second.* This represents an amount of energy calculated by various authorities at from 5,500,000 to over 10,000,000 horse-power, according to location of the power stations and the methods adopted for development. Naturally, as electrical science advanced, public interest centred first upon Niagara not only because it was so long known as a natural wonder, and the power so enormous but because of the great population to the west and east who could use the power when developed.

The creation of the national parks on both sides of the river also had an important, though undesigned, influence on the coming conversion of Niagara's power to the uses of the people. From the time an account of the cataract was published by Father Hennepin in England in 1698 this spot has been an attraction to an increasing stream of visitors from every part of the world, but for over half a century before the establishment of the parks, the place was infested by parasites of all sorts

* A committee of the Legislature of the State of New York estimated its flow at 256,000 feet per second, and the total theoretical power of the fall from Lake Erie to Lake Ontario at 8,192,000 horse power.

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who took merciless toll from the tourists. Extortion prevailed from the hackmen, who would threaten personal violence to any visitor questioning his fare, to the estate owner who could block the way to the best points of view. The hackmen were paid commissions for directing tourists to the bazaars or to hotels, and the system of piracy was reflected through the whole community.

On his visits to the falls during his term of governor generalship of Canada from 1872 to 1878 Lord Dufferin was grieved by "the hucksters, peddlers and sharpers who swarmed at all the points of interest levying tolls at every turn on the unfortunate tourist."*

Lord Dufferin, on meeting the governor of the State of New York in 1878 suggested joint action by the governments of New York and Ontario to establish a park from which the public could view the falls without fee or annoyance. Governor Robinson responded and the result of the appeal of these two men was the formation of a public park system on each side of the river, the New York park being known as the "State Reservation of Niagara" and the Ontario as the "Queen Victoria Niagara Falls Park" administered by government commissions each working in harmony with the other. The Ontario park was opened on the Queen's birthday, 24th May, 1888, and then comprised 154 acres. It has been enlarged from time to time till it now comprises 1,178 acres stretching along the river front thirty-five miles.

It was Lord Dufferin's idea that the park should be a national one, and yielding their "provincial rights" the Ontario

* See Annual Report Park Commissioners for 1895. In an address to the Society of Artists, Toronto, in 1878, Lord Dufferin, referring to Niagara Falls, said: "The pleasure the pilgrim may have derived has been miserably marred by his experience at the hands of the various squatting interests that have taken possession of every point of vantage. When his whole being is about to be given to the natural beauties, his imagination and poetic faculties are suddenly shocked by a demand for ten cents."

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government in 1880 passed an enabling act, giving the province's consent to Dominion ownership. The province had the legal right to the lands and the bed of the river, but the premier of the province, Sir Oliver Mowat, who had won in the constitutional contest—the "Rivers and Streams Bill" case—to establish this claim, thought it well that such a park should be national. The Dominion government failed to act, and after a lapse of five years the Ontario government took up the duty and at a cost of \$525,000 acquired the lands, extinguished the privileges of the private exploiters, prohibited gambling, the sale of intoxicants and soliciting by the cabmen within the park. But the revenues from such concessions as had to be maintained in the public interest proved disappointing, and as there was criticism of the cost, the provincial government inclined to the opinion that the province should not be taxed for the advantage of the local community.

In this dilemma the park commissioners turned to the idea of leasing a water power right. Thus by the advance of electrical science the field of exploitation was suddenly enlarged from the ten cent fakir in natural scenery to the ten million dollar concessionaire who was to take toll on the powers of nature.

CHAPTER IV.

The Apostles of Power, and their Missions to Niagara.

The appetite for power had already been whetted by what was happening on the American side of the Niagara. The company known till recently as the Niagara Falls Hydraulic Power and Manufacturing Co., (now known as the Niagara Falls Power Co.) had been incorporated as far back as 1853, planning to build a canal by which water would be taken from a point above the falls and led to the cliff below the falls where shafts for the wheels would be cut to a depth as great as would be safe for the small water wheels of those days. It was not till 1881 that water power was converted into electrical energy, this company using arc light machines for lighting stores and streets; but by 1895-6 the advances in electrical science, and the improved form of turbines, set horizontally so as to eliminate trouble in the bearings, made it possible to use for the first time the full head of 210 ft. from the top of the cliff to the river below the falls, where a turbine of 6,850 h.p. was installed.

So far as is known the first application of electricity as a motive power for railways was made in Toronto, at the Exhibition of 1883, where passengers were carried over a short track.

The first transmission of electric energy by water power in Canada was carried out by the late John R. Barber, who transmitted a hundred horse power from a dam to his paper mill near Georgetown, Ont., two miles distant. It was used at the mill both for power and light, and was first operated in 1888. It is believed to be the first long distance installation in the world. The first transmission line in the United States was installed at Pomona, Cal., in 1891.

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By 1891 electric traction had advanced so far that the city of Ottawa was operating cars in the winter, overcoming trouble from snow. In 1888 we find the park commissioners of Niagara Falls inviting proposals for an electric scenic railway from Queenston to Chippawa above the falls, with the double object of obtaining revenue for park purposes and giving the tourist the means of seeing the sights without depending on the cabmen who continued to make as much trouble as possible for the commissioners. Water power privileges were to be included in the concession. It was not till 1892 that a company of Canadians known as the Niagara Falls Park and River Ry., took up this enterprise and agreed to pay an annual rental of \$10,000. The railway was speedily built and is still operated on the original terms. The rental was the first regularly received from any electrical development at the Falls and was sufficient to pay for the maintenance of the park at that period.

The closing decade of the nineteenth century saw remarkable progress in electricity and engineering appliances. Arc lighting was being rapidly introduced into cities; factories were being operated by electric motors (the first in Canada having been introduced in the newspaper plant of the St. Catharines, Ont., *News* as early as 1887) and by 1896 thirty urban and inter-urban railways in Canada were electrically operated.

The solution of the problem of long distance transmission marked the real beginning of the era of big machinery and large units of power, and naturally the most attractive spot for such adventure was this, the world's most celebrated waterfall. The installation in 1900, by the Canadian General Electric Co., of a dynamo of 200 h.p. for the Niagara Falls Park & River Ry. was a notable event as it was the largest yet built in Canada; but in a few years dynamos of 15,000 h.p. were being designed for the power houses here, and generators of 52,500 h.p. are at present being made for the Commission.

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In 1890 we find one of the syndicates seeking a power privilege at Niagara Falls pleading for an extension of time on the ground that experiments were then being made at the works of Ferranti, the electrical inventor, at Deptford, to determine the range of long distance transmission. Later in the same year it was reported that Ferranti was able to transmit electricity a distance of nearly ten miles "at the tremendous pressure of 10,000 volts." Before the close of the same year it was announced from Germany that the voltage on long distance lines had been increased to 17,000 volts and the range of transmission to over 100 miles, with very slight loss in transmission. In April, 1901, the Bay Counties Power Co. of California began to deliver power at Oakland from a generating station at Colgate on the Yuba River 142 miles away, and in November electric current from the same source reached San Francisco 222 miles distant. With increase in the reach of the current by increased voltage came a relative decrease in losses in transmission, so that by the time electric energy was transmitted from Niagara Falls to Toronto the voltage in use had increased from a few thousand volts to over 100,000 volts. That by which the current was carried from Niagara Falls to Toronto, London and other Ontario cities by the Hydro-Electric Power Commission of Ontario is transmitted at a voltage of 110,000, the highest attained in practice up to that time.

These revelations of the possibilities of electric power, so much more flexible than any other source of energy in its applications as a motive power and for lighting, not to speak of its uses for scientific purposes and in electro-chemical industries were keenly and confidently followed by those who knew the financial advantages of converting natural resources into some form of taxation. The revelations were studied with equal keenness, but with anxiety, by those whose duty it was to watch the interests of the people who were to pay these taxes.

On the American side, the Niagara Falls Power Co., on

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obtaining its power privilege, built a power house with an initial capacity of 50,000 h.p., its plans providing for an ultimate capacity of 100,000 h.p. It had, however, the right to divert sufficient water for 200,000 h.p. In connection with this company the Cataract Power and Conduit Co., with headquarters in Buffalo, was formed to distribute the power in Buffalo twenty-five miles distant. It may be noted that the Cataract company speedily obtained a monopoly of electric power and lighting in Buffalo, and under the name of the Buffalo General Electric Co., has maintained it ever since at prices far higher than are paid by Toronto which derives its electric energy from the same source, a distance of ninety-two miles.

As long distance transmission began to be realized, the attention of power exploiters was turned to the Canadian side of the river, where the volume was greater. At the brink of the Falls the river is divided by Goat Island, and because of the trend of the current above the fall, and the fact that the bed of the river is lower at the Horse-shoe,* or Canadian falls, over seven-eighths of the entire volume of the Niagara flows over the Canadian side.

To get the advantage of this greater volume and more favorable sites for a power house, a company of United States capitalists applied in 1889 to the Queen Victoria Niagara Falls Park Commissioners for the right to generate power on the Canadian side and offered an annual rental of \$25,000 a year for a term of ten years and after that an increase of \$1,000 a year till the annual rent should be \$35,000. Through internal differences and delay the deal was never executed. Meantime some English capitalists associated with the inventions of Ferranti took up the proposition and under the name of the Canadian Niagara Power Co., obtained the privilege on the same

* Average height of Horse-Shoe Fall, 159 ft.; average height of American Fall, 165 ft.

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terms of rental. This contract came near to consigning the Canadian falls to a monopoly like those on the American side, leaving these great powers like a Samson in the lap of Delilah, for this group of English capitalists were to have the sole right—apart from the franchise already given to the electric railway company—of using the waters of the Niagara within the park for a term of one hundred years. Providentially for the public safety, there was a condition that the company was to have ready for use 10,000 horse power by May, 1897. The company failed to carry out the terms although the park commissioners had reported that they had “the command of unlimited capital” and the counsel of the “greatest English electrician of the day.”

By this time the public, as well as the park commissioners, realized the danger of giving such a monopoly to a private company, and when the charter was taken up by a group of United States capitalists already interested in hydro-electric developments on the United States side, a new agreement was made with the monopoly clauses deleted and the term shortened to fifty years. The company, however, had the option of renewals by ten-year periods up to a total of 110 years. This company had the right to take sufficient water for 100,000 h.p. at a rental of \$15,000 a year, up to the year 1949. For all power over 10,000 h.p. and up to 20,000 they were to pay an extra \$1 per year for each horse power, and 75c. extra for each horse power from 20,000 and up to 50,000 and 50c. for each horse power over 50,000. The company which was capitalized at \$3,000,000 agreed to have 20,000 h.p. ready by 1904. They went to work so energetically that they actually had 50,000 h.p. ready by that date.

The next company that was successful in its suit for a power site within the limits of the Canadian park was the Ontario Power Co. which was also financed by United States capitalists, whose expectation was that they would be able to export to the

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New York side any surplus that could not find a market in Ontario. This company, in 1900, acquired a Dominion charter originally granted in 1887, and planned for a development of 180,000 h.p., on terms similar to those granted the Canadian Niagara Power Co., the license to be a term of fifty years.

The third company to obtain a power privilege was a corporation entitled the Electrical Development Co., headed by three Canadians: ~~all three~~ were residents of Toronto and shareholders in the Toronto Street Railway Company and the Toronto Electric Light Co., then the largest consumers of power in Ontario. The Electrical Development Company was capitalized at \$6,000,000 and organized in 1903. By its agreement, made in 1905, the company was to have water enough to develop 125,000 h.p. and was assessed a rental on terms similar to those made with the other companies. The agreement, however, was never ratified by the Lieutenant-Governor in Council.

In course of time these companies exceeded the power stipulated and the park commissioners demanded rental for the excess power. The Canadian Niagara Power Co. paid the demand but the other companies contested the claim which in the case of the Electrical Development Co. was kept before the courts till 1920. There are about twenty other incorporations whose projectors had plans for using water on either side of the Niagara and tributary streams or for transmitting and distributing but whose powers are dormant or have expired by lapse of time.

CHAPTER V.

The People's Claim to the Public Resources—The Struggle for the Control of Niagara.

The people of Ontario beheld then, at the dawn of the new century, electrical energy to the amount of over 400,000 h.p. in process of development at Niagara Falls at half the price of power produced by coal, but all under the control of private companies. While the seekers after profitable franchises were thus early awake to the value of Niagara power, others began to study the relation of the great natural resources to the public welfare. In the majority of Canadian cities the administration of municipal services was still in the hands of private companies. As the variety of uses of electricity increased and the range of transmission extended, so its importance increased, as a means of rendering municipal services cheaply available to all. It was manifestly important to manufacturers to cheapen production by this means, and of equal importance to merchants and citizens to cheapen the cost of transportation. Ontario had become the seat of more manufacturing industries than any province of the Dominion.

On the other hand the rise of the lobby system in the federal and provincial parliaments whereby private interests were obtaining legislation enabling them to take away the right of self-government from cities and towns, roused the people to the dangers of government by private corporations. Under the powers granted in some cases a company could in practice take possession of a city's streets, damage property or interrupt the civic works and prevent it from exercising its public powers. As for service connected with lighting and power, few of the companies published any standard rates. Any applicant for

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power or commercial lighting would be charged, not by the amount of his requirements but by his ability to pay or the urgency of his needs, or otherwise how near the company could come to the cost of steam power in each case, just as the railway companies had been in the habit of fixing rates on the principle of charging "all that the traffic would bear."

To resist the encroachments of these corporations a convention of representatives of Canadian Municipalities was held in Toronto in 1901 when a "Union of Canadian Municipalities" was formed with O. A. Howland, Mayor of Toronto, as president, and W. D. Lighthall, Mayor of Westmount, Que., as honorary secretary. The work of this union made members of parliament a little more careful about handing over to private parties the right to the public resources.

The defenders of civic rights were aided by many public men who raised the question of the effect on navigation of withdrawing such large amounts of water from a river which was not only a navigable channel but was an international boundary water.

Another class who rose in protest against the private monopoly of Niagara power was one whose influence could not be ignored because the question of profit or utility did not enter into their reasoning. This class comprised the artists, poets and lovers of nature who for three centuries had regarded these falls purely as a manifestation of the majesty and power of the Creator. The words of Tom Moore, the Irish poet who visited the falls in 1804, might be taken as an expression of the sentiments of this class: "I felt as if approaching the residence of the Deity. . . . My whole heart and soul ascended towards the Divinity in a swell of devout admiration. Oh, bring the atheist here and he cannot return an atheist! I pity the man who can coldly sit down to write a description of these ineffable wonders; much more do I pity him who can submit them to the admeasurement of gallons and yards."

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Various societies of artists, naturalists and scientists, petitioned the United States Congress and Canadian Parliament on these grounds and the result of the concentration of interest on the Niagara problem, was that in 1906-7 the question was referred by the two governments to the International Waterways Commission to whom had been committed the amicable adjustment of difficulties arising out of navigation rights and the variation in lake levels. This body had already declared it to be in the best interests of the two countries that "in all navigable waters the use for navigation purposes is of primary and paramount right." The result of the Commission's investigations was a joint recommendation that while they were not fully agreed as to the effect of these diversions of water, no more than 36,000 cubic feet per second should be taken from the Canadian side and no more than 18,500 cubic feet from the United States' side. This provided for the diversions permitted to the four companies on the Canadian side already referred to, with an allowance of 1,800 feet for the Welland Canal and its tenants; and, on the American side for the two before-named companies, with an allowance of 400 feet to the Erie Canal and its tenants. In the amount allowed on the United States' side, account was taken of the 10,000 cubic feet per second diverted from the upper lakes by the Chicago drainage canal. This made an apparent balance in favor of Canada, but as the early demand for power came more largely from the United States than Canada, permission had been given for the export from the Canadian companies of power amounting to a total of 160,000 horse power, equivalent to 12,000 cubic feet per second under Niagara conditions. These permits were revocable by the government, but as a matter of fact, the export of current from the Canadian to the American side has been continued. That is the situation to-day and no permits have since been given to private companies for the abstraction of water from these falls. (The Chippawa power works of

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the Hydro-Electric Commission are referred to in another chapter.) The principle acted on by the International Waterways Commission has been qualified by the treaty between Great Britain and the United States, ratified in 1909, and known as the International Boundary Waters Treaty, which lays down a rule that three primary considerations shall guide the re-organized Waterways Commission in disposing of such waters; these considerations to stand before all others in the order of their statement, as follows:—

1. Uses for domestic or sanitary purposes.
2. Uses for navigation, including the service of canals for purposes of navigation.
3. Uses for power and for irrigation purposes.

It will be noticed that no place is given in this Treaty to the claims of those who would preserve Niagara Falls, or any other boundary waters, for the sake of their attractions as a natural wonder.

Prophets and preachers of the gospel of the public right to the public resources, were found here and there among municipal officers, members of the legislature and the newspaper press, and by the time long distance transmission of electricity had begun to replace coal as a motive power their voices began to have an influence on public policy especially in the province of Ontario. The belief that an area of 150,000 square miles of territory, having a total population at that time of over a million and a half, or nearly three-quarters of the inhabitants of the province, might be served from Niagara Falls alone, replacing steam-raised power by a cheaper prime mover, would challenge the interest of manufacturers, merchants and city and rural communities alike.

One important result of these discussions was the appointment of an investigating committee by the Board of Trade of Toronto, under the chairmanship of the late Walter E. H. Massey. This committee, reporting in April, 1900, expressed

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the opinion that while electrical power was not as important in procuring new industries for the city as was supposed, cheaper power would be a great boon, especially to the smaller manufacturer. Hence the committee suggested that measures should be taken to procure a connection with one of the companies operating at the Falls, especially as it was not to be expected that electrical power generated by steam could ever be obtained much cheaper. The Toronto Electric Light Co. had signified its intention to bring power from one of the new generating companies organized at the Falls, and the question occurred to the committee whether Toronto as a city should control the proposed Niagara Falls connection. "This" the committee concluded "is a matter for consideration, and one on which your committee are not prepared to report at the present time, not having sufficient data at hand."

The report of this committee, whose chairman was known to have a strong interest in problems of social as well as industrial advancement, was soon to bear fruit.

CHAPTER VI.

Genesis of The Hydro-Electric Power Commission.—Reports of the First Commissions.

After preliminary local discussions an informal convention was held in June, 1902, at the town of Berlin (now the City of Kitchener) the delegates comprising representatives from a number of cities and towns extending from the Niagara district as far north as Toronto and as far west as London. The last named city was represented by the mayor. This was Mr. Adam Beck (now Sir Adam Beck) who became the fearless champion of the public ownership of water powers, and whose Knight-errantry in this cause has so transformed public opinion within the last few years that the days of the domination of municipal affairs by private corporations may be said to be numbered.

The chair was occupied by Mr. E. W. B. Snider, a manufacturer of St. Jacobs, who afterwards became chairman of the first power commission of the province.

There were two classes represented at the meeting: those who desired to obtain cheap power as manufacturers, and those who had the public service needs of the municipalities in mind; but both were unanimous in looking to Niagara as the only source of cheaper power. Alderman F. S. Spence of Toronto, one of the first and most consistent champions of the complete ownership of electrical distribution systems by the municipalities, first proposed that the municipalities should unite in asking the Ontario Government to appoint a government commission invested with power to arrange for the transmission of electrical energy to such cities, towns and villages as desired to take power. This commission, he suggested, would issue bonds to

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cover the cost of the transmission lines, and these bonds would then be covered by the bonds of the participating municipalities and deposited with the commission. The municipalities would in effect, buy power from the commission, which would own the main lines and in turn sell power to manufacturers and while supplying power and light for municipal purposes would furnish light to the citizens at an even rate. This would prevent the power and lighting services from falling into the hands of private monopolies and would secure to the industries of the province the advantage of much cheaper electrical energy than was obtainable from private companies.

Mr. C. H. Mitchell (now General Mitchell) then consulting engineer of the Ontario Power Co., was present by invitation. He informed the meeting that no power would be obtainable from Niagara Falls till October of the next year, but by that time his company would be able to deliver current to manufacturing towns at \$17 per h.p. per year for a 24-hour day. After various proposals were made—one of them being the formation of a joint stock company by the manufacturers of the different towns for their common purpose and incidentally the supply of light and power for general use—the meeting adjourned and in July another meeting of representatives of these municipal councils was held at Berlin. Messrs. E. W. B. Snider, D. B. Detweiler, of Berlin, who had acted as secretary, and F. S. Spence, of Toronto, were, at this meeting, appointed a committee to obtain information. The committee reported to a meeting held in Berlin, February 17th, 1903. So strong had become the public interest in the movement that at this meeting about ninety municipalities and individual manufacturers were represented, including Toronto, Stratford, London, St. Thomas, Woodstock, Ingersoll, Guelph, Hamilton, St. Catharines, Brantford, Waterloo, Galt, Berlin, St. Mary's, St. Jacobs, Bridgeport, etc.

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The committee reported their belief that power could be obtained, delivered at Niagara Falls at \$7 or \$8 per continuous horse power per year; or from \$14 to \$15 delivered to the various towns concerned. The committee recommended an application to the legislature for authority to develop, transmit, buy and sell electrical energy and to permit the municipalities to co-operate to distribute the same. After discussion the following resolution was submitted by Mayor Urquhart, of Toronto:

That we respectfully urge upon the government of Ontario the advisability of the government building and operating as a government work, lines for the transmission of electricity from Niagara Falls to the towns and cities of Ontario, or that they extend the powers of the present Niagara Falls Park Commission so that they may as a public work build and operate the necessary lines to transmit electric energy from Niagara Falls, and that for this purpose they be empowered to issue debentures which might be guaranteed by the government but which would eventually be paid out of the receipts from the sale of electrical energy, thus entailing no charge on the provincial funds, and that the municipalities here represented call their representatives in the legislature to urge on the government to carry out this resolution. After an amendment striking out the reference to the park commission the resolution was adopted, along with another resolution asking the government not to part with any more power privileges to private parties.

The subject of Niagara power continued to be agitated in the towns and villages represented at the first conferences. The council of Guelph demanded, and afterwards acquired, possession of the electric lighting plant hitherto carried on there by a private company. In the case of Toronto there was a strong movement in favor of obtaining a transmission line direct to Toronto for the purposes of that city alone, and in January, 1903, application was actually made to the legislature for the

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right to generate and transmit Niagara power. While the application was before the legislature, a joint meeting of a committee of the city council and a committee of the Toronto branch of the Canadian Manufacturers' Association was held at which Mr. P. Judson, engineer of a company known as the Hamilton & Lake Erie Power Co., offered to supply the city with 30,000 h.p. at \$20 per horse power delivered in the city, or \$10 per h.p. if the city built its own transmission lines. The company proposed to obtain its power by drawing water from the Welland River, diverting it into the Jordan creek and bringing it to the same escarpment which gives the fall to the Niagara, but at a point some miles to the west where a drop of 100 feet more than at Niagara could be obtained. The scheme was still-born but a similar proposition to develop power near DeCew's falls was carried through as will be recorded.

The Ontario legislature refused the application of Toronto on the ground that the city had no matured plan for exercising the powers asked for, but the refusal was no doubt influenced—apart from the efforts of the private corporations to choke off competition—by the objections of other municipalities where the people held that if Toronto were to have its independent line they would be handicapped in financing a separate system for relatively small communities. Members of the government, including the premier, Hon. Geo. W. Ross, took the stand that the financial obligations involved both in the Toronto proposition and in the plan proposed at the conference in Berlin were for the benefit of that section within electrical reach of Niagara, and that the whole province should not be called on to subsidize one section, thus giving it an industrial advantage over other regions beyond transmission distance.

While the legislature was thus putting Toronto and the other municipalities to such a test as to "a matured scheme" as was not applied to private corporations, we find that at this time the owners of the Toronto and Mimico Railway Co.

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(electric) was applying for power to extend its line to Hamilton; and the Toronto Electric Light Co. was making application for the sole right to power on the Canadian side of the Niagara. The Union of Municipalities opposed this and obtained the support of civic corporations as far away as Winnipeg.

Events were now moving fast, and the light of Niagara was beginning to penetrate the legislative chamber at Toronto. Led by Ald. Spence, the Toronto council now threw in its lot unreservedly with the other civic bodies, whose next meeting was held in that city in February, 1903. Ald. Spence declared that what the cities and towns wanted was cheap power, and it seemed to him that municipal ownership under government control was the best means of obtaining it. Other speakers reported that the towns of this region were more deeply interested than ever.

A large delegation from the municipalities now interviewed the premier and found him more disposed to consider their claims. Discontent with his administration on other grounds probably had its influence in this change of attitude. Mr. Snider, of St. Jacobs, pointed out the loss that would ensue if these towns were to struggle on with the high cost of steam-raised power while other places had the advantage of power at half the cost. It was estimated that 20,000 to 25,000 h.p. could be used by these towns, exclusive of Hamilton and Toronto. If the government would not go on with the work the next best thing was to allow the municipalities to do it. Ald. Spence reminded the premier that the government had spent large sums in developing the mineral resources of the province, and rightly; but the mineral resources may one day be exhausted, while the resource of Niagara power may be deemed to be eternal. If this resource were placed in the hands of the people the aim would be to secure their largest possible use at the lowest cost; and he was confident that if their plan were carried

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out the present cost of power would be cut in two. He suggested the municipal co-operative plan under a commission of three to five men; and to prevent the distribution plan from being held up, authority should be given to enable them to develop power also.

In reply, Premier Ross said he was informed that the power now provided for at Niagara could not be used for a quarter of a century to come. The government could not directly undertake the scheme but, with the assistance of those concerned, would bring in a bill enabling the municipalities to carry out their plan.

The government was more seriously concerned with the power question when the leader of the opposition, Mr. James P. Whitney, in a speech at Newmarket at this time, protested that the granting of a third power franchise at Niagara was all wrong, as was the unrestricted export of the power already developed. As for the argument that this was a matter of sectional advantage, the premier forgot that large sums had been devoted to the development of New Ontario, yet the whole province was asked to pay for it. Mr. Whitney held that the government should investigate the problem of supplying power to all places within 150 miles of Niagara, or appoint a commission to provide the means of enabling the Union of Municipalities to do so.

To bring some fresh light to bear on the question of public ownership the government, in May, appointed a special committee to report on the municipal ownership or operation of public utilities. Mr. Avern Pardoe, now librarian of the Legislative Library, was appointed secretary and his report was the most comprehensive compilation of information on the subject up to this time in Canada. In it appeared the first return of the municipal activities of the province and this has been maintained annually since as the report on the "Reproductive

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Undertakings of Ontario Municipalities." This report though incomplete showed that 126 municipalities in Ontario were now operating their own waterworks, electric light and gas works, the majority of these services having been taken over within the preceding ten years.*

With these evidences of the trend of public opinion before them the government at least made good its promise, and in June of this year passed an act for the "Construction of Municipal Power Works and the Transmission, Distribution and Supply of Electrical and other Power and Energy." It gave any two or more municipalities the authority to appoint commissioners to examine into and report upon the establishment of works for producing power, heat and light, the probable cost and desirability of the undertaking and the proportion of cost to be borne by each of the contracting bodies. It conferred on the municipalities the power to act on the report of the commissioners and to establish the works under a Board of Commissioners to be nominated by the Chief Justice of Ontario. The Board would have the power to acquire or construct works for generating, transmitting and distributing electricity, or other power, and fix the rates to be charged in each case. Finally, authority was given for the issue of bonds for carrying out such works; and the Act directed that in the event of such commission being appointed the commissioners should report to the appointing municipalities particulars as to the power required and consumed, the capital cost and operating costs, with the share of each, rates, etc., and that before action, the proposal should be submitted to a vote of the electors through a by-law.

Under the provisions of this Act representatives of seven

* A report by Leo G. Denis, Hydro-Electric Engineer of the Commission of Conservation, on "Electric Generation and Distribution in Canada," published in 1918, shows that of the 752 electrical distribution systems in Canada 389, or more than half, are now municipally owned.

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municipalities—Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph—met in Toronto in August, 1903, and appointed an investigating commission composed of Messrs. E. W. B. Snider, of St. Jacobs; (chairman), P. W. Ellis, of Toronto; W. F. Cockshutt, Brantford; Adam Beck, London; and R. A. Fessenden, electrical engineer, of Washington, D.C. J. C. Haight, barrister, of Waterloo, acted as hon. secretary. All the commissioners gave their services free, except for a nominal fee paid to Prof. Fessenden. Messrs. Ross & Holgate, engineers, of Montreal, who were appointed to make the technical investigations, gave their services at cost. The fund for the investigation was provided, not by the Provincial Government, but by municipal subscriptions amounting to \$16,000, of which Toronto contributed \$11,756, and London \$1,542.

No statistics of power consumption were then available, but Mr. Ross opened an office in Toronto, and a staff of engineers was organized under Arthur V. White* to canvass from factory to factory, to explain the advantages of conversion from steam to hydro-electric power, and to learn to what extent the power users would co-operate in the movement. In addition to the prejudice of many steam users who did not admit the superiority of electric power, and who imagined that the winter's heating which they got from the exhaust-steam of their engine cost them nothing, it was found that many firms had recently been tied up in long-term contracts with the electric company.

Meantime the investigations under Mr. Cecil B. Smith, to be referred to hereafter, were proceeding in the wider field outside of Toronto and carried on with such speed and energy that the two reports were given to the interested municipalities and to the public within a few days of each other in March, 1906.

Dealing with the criticism anticipated from opponents of public ownership, the commissioners, in their comments on

* Now Consulting Engineer to the Commission of Conservation.

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the Ross & Holgate figures, said: "The basal fact that power and light can be supplied under a municipal development, properly carried out, under engineering conditions equal to those of its competitors, at prices beyond the reach of permanent commercial competition, is not open to argument. Competing (private) companies have to pay higher interest rates on their bonded debt, and in addition they have large issues of capital stock on which dividends have to be earned. Whether rates be fixed by the companies voluntarily or under Government regulation, regard must be paid to these conditions and the rates loaded accordingly. No criticism directed at isolated facts or figures will alter these broad underlying conditions, from which the general public will derive benefits otherwise unattainable." The commissioners did not think private companies could complain of municipal competition, for the private trader and manufacturer has to face the risks of loss and the competition of rival businesses, and expects no indemnity from the consequences of this competition. Moreover, the industrial future of the province depended on the leverage of the new power.

In conclusion, the commissioners recommended that the municipal development be carried out, and suggested a fourth site in the Niagara Falls Park for the proposed installation, which would require two or three years to complete.

While the work of this commission was being discussed, before the actual publication of its report, a new election was held, resulting in the defeat of the Government, and the advent to power of the opposition leader, Hon. James P. Whitney, who had been a strong opponent of the private monopoly of the water powers. During the campaign preceding the election, he had said that Niagara power should be as "free as the air," and this expression was scoffed at by the power magnates as a proof that the idea of public ownership was utterly visionary. What Mr. Whitney meant, as he explained, was not that Niagara power would cost nothing to develop, but that the opportunity

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for its use should be available on equal terms and free from the exactions of private monopolists. On coming into office he lost no time in demonstrating his sincerity regarding the hydraulic power question.* The result was that the first municipal power Act was repealed, and on the 5th of July, 1905, an Act was passed creating a "Hydro-Electric Power Commission of Ontario."

Mr. Adam Beck, Mayor of London, had been elected to represent that city in the Legislature, and having, as a member of the investigating commission, made an earnest study of the problem, was invited to become a member of the Cabinet, for the purpose of working out a power policy for the province. As a large manufacturer, he was familiar with the industrial requirements, and by his experience in municipal affairs he had gained a thorough understanding of the huge obstacles to be overcome before complete co-operation could be attained among the municipalities. In choosing as chairman of the commission a man of such experience and of such abounding energy and steadiness of purpose, the judgment of the new premier was to be amply justified by public opinion. Mr. George Pattinson, of Preston, also a member of the Legislature, and Mr. P. W. Ellis, of Toronto, were the other commissioners.

The demand that the great water powers of Canada should be controlled in the public interest now became general. Not one Niagara, but many Niagaras, could be dealt with. The commission met this demand in a statesmanlike way. It secured the services of Mr. Cecil B. Smith, a young Canadian engineer of great ability, who had been resident engineer of the Canadian Niagara Power Co., and under his direction a great public service was rendered to the province by a comprehensive survey

* On taking office, Sir James Whitney found an agreement prepared by the late Government, but not yet officially executed, giving another 125,000 horse power to the Electrical Development Co., at Niagara Falls. Sir James promptly repudiated this proposition.

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of the water power resources of the more settled regions of Ontario. Five reports were issued in succession within about a year. The first report covered the region from Niagara Falls westward to the Detroit and St. Clair Rivers, and reaching to Toronto on the north; the second the Trent district, so called, north of Lake Ontario and embracing the water sheds of the Trent and Moira Rivers; the third report dealt with the counties whose rivers chiefly flowed into Lake Huron and Georgian Bay; the fourth report treated of the Lower Ottawa and Upper St. Lawrence regions, comprising the eastern counties of the province; while the fifth considered in a general way the water powers of the great, but as yet sparsely settled territory in the districts of Algoma, Thunder Bay and Rainy River to the north and east of Lake Superior.

The reports of the investigating commissions were extensively quoted in the newspapers and discussed by boards of trade and other public bodies. The two reports, while differing in details and in methods of computation, agreed in the main as to the market that could be created for power and the savings that might be made by a wisely administered co-operative system compared with the private company service. These publications made a deep impression, as the data on which the reports were based came from hydraulic and electrical engineers of undoubted standing.

In one paragraph of the report of the Hydro-Electric Power Commission, it was stated that the tendency with private corporations was "to amalgamate or otherwise destroy competition, and then fix the price according to the slight saving which they may be able to induce particular customers to make. The natural result of this has been to force individual power consumers, where the circumstances justified it, to instal generating plants of their own, rather than to place themselves at the mercy of large combinations formed for the purpose of preventing competition. The same result, of course, occurs where there

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has never been a competing company. Specific illustrations of this are found in the cities of Montreal, Buffalo and Hamilton. On the other hand, in the City of Ottawa, where the municipality secured a distributing plant, in anticipation of an attempt to throttle competition by a combination of companies, lower prices prevail, based on the cost of production."

A staff of seven hydraulic and electrical engineers was organized by the new commission to make a survey of the water powers developed and undeveloped in the districts mentioned, and to report the present and prospective demand for hydro-electric power; to estimate the capacity of the water powers and the capital cost of their development including cost of transmission lines to the various centres of consumption; the prices that would require to be charged to cover the cost of operation and maintenance; and to estimate the savings to consumers compared with prices now charged. The commissioners were also asked to obtain information regarding existing private developments such as their cost and the rates charged. A canvass was made by expert assistants in each town and district, and by this means it was learned how many of the present users of power would adopt electricity if available at a saving in cost. An immense amount of information was gathered in these reports, which constituted the first hydro-electric power census of Ontario. Comparisons were also made between hydro-electric power and steam-generated power or gas power, so that the municipalities in each sub-division of a district might know the bearing of a hydro-electric system upon their own particular needs.

As already stated, there were seven municipalities that had undertaken to become the nucleus of the projected system taking power from Niagara, and the figures gathered by Messrs. Ross & Holgate indicated that the total present consumption was 73,631 h.p., which might be increased to about 88,000 h.p. in the next two years; but the net present consumption—that

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is the total which the operating commission could expect from power users who had no special reason for retaining steam for heating and industrial uses combined with power purposes—was only a little more than 55,000 h.p. There were eleven other civic corporations along or near the lines of the seven, and if these eleven joined the movement the cost to the seven would be somewhat reduced. On a hundred thousand horse power development the co-operative system with a membership of eighteen municipalities would realize the following savings from the prices then being paid to the private companies: arc lighting, 45 per cent.; incandescent lighting, 21 per cent.; industrial motive power, 69 per cent.; other motive power, 77 per cent. In this estimate interest at $4\frac{1}{2}$ per cent., and a 40 year sinking fund was charged against the municipalities. With a 60,000 h.p. plant the rates that should be charged for motor service would vary from \$15.73 per year in the case of Toronto, to \$23.87 in the most distant city, London; whereas the existing cost for steam power varied from \$24 to \$111 a year per h.p., according to the size of the generating plant.

In the first report of the Hydro-Electric Power Commission, dealing with Niagara, it was estimated that the cost of incandescent lighting would be reduced, on commercial incandescent lighting from 12 cents per kilowatt hour as charged by the private lighting company, to 6 cents, and on residential lighting from 8 cents to 5 cents per kilowatt hour. The private company's motor rates in Toronto, it was found by this commission, varied from \$51 to \$180 per h.p. for a 10-hour service, where the commission's scheme would reduce it to rates varying from \$22.50 to \$45, according to plan adopted. The private company in Buffalo, using Niagara Falls power, was then charging rates for motor service varying from \$27.71 to \$117, and, for lighting, prices ranging from 4 cents to 12 cents per kilowatt hour. In Montreal, when two companies were competing, the rates charged for motor service were \$50 per h.p., but when one

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company absorbed the other these rates went up to figures ranging from \$45 per h.p. for a 50 h.p. motor to \$120 per h.p., and incandescent lighting rates jumped from 12½ cents to 14½ cents per kilowatt hour. The commission estimated that if Niagara power were distributed in Toronto on the cost basis suggested, the saving to that city would amount to \$684,000 a year.

In the agreement with the Park Commission the companies each bound themselves to make half-yearly returns of the power generated and sold, but on visiting Niagara Falls the Hydro-Electric Power Commission found that no such returns had ever been made to the Park Commissioners or the Government. The Canadian Niagara Power Co. and the Hamilton Cataract Power Co. now gave the commissioners the returns asked for, but the Electrical Development Co. and the Ontario Power Co. refused to give any information, or give any reason for the refusal. The companies were bound also, on request, to make a return to the Government of the prices charged, but the request had not been made and the two companies declined to enlighten the commissioners on this point. No appraisalment of these plants was made as the works were in different stages of construction, but the sections then partially completed had a combined capacity of 150,000 h.p. for delivery, and this was considered more than enough for any demand likely to arise in Ontario in the near future. The Ontario companies were, in fact, looking to the industries on the New York side for a market for power; and few of those on either side concerned with the business dreamed that hydro-electric power would of itself, in a few years, create electro-chemical industries which could absorb more power than the whole of the Niagara companies could then furnish. Nor did they anticipate that these power resources would cause Niagara Falls to grow in population from about 19,000 in 1900 to a city of 60,000 in 1920; and that the Ontario town of Niagara Falls, though later in feeling the

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electrical impulse, would develop from a few hundreds to a present population of over 14,000, with a corresponding influence on neighboring cities and towns. If these neighboring cities and towns, such as St. Catharines, Thorold, Merritton, Welland, Fort Erie, Bridgeburg and Port Colborne, all within fifteen miles of the Niagara River, are taken into account, the urban population of the district is about 50,000. At this time the Canadian Niagara Power Co. was only generating about 17,000 h.p., of which 15,000 h.p. was sold to the Niagara Falls Power Co. on the New York side. The Ontario Power Co. was not yet ready to deliver the first units of the 30,000 h.p. which it had contracted for in New York state. The Electrical Development Co. were installing its first 50,000 h.p. for Toronto, but this would not be ready till 1907.

While the two commissions were in substantial agreement as to the advantages of municipal control of the distribution systems, there was an important difference in their judgment of the methods of attaining the end. The Hydro-Electric Power Commission estimated that it would require four years to complete a plant at the only commendable site available and consequently advised that the municipalities should build their own transmission lines and purchase the power that was then begging for customers. The Hon. Mr. Beck had declared that he was not antagonistic to capital nor to private corporations, and the fact that the commission soon afterwards made a contract with the Ontario Power Co. for 100,000 h.p. verified his statement. It was the unbridged gulf between the cost of service for public purposes and the rates actually charged, that determined the municipalities to go forward. At a large public meeting in Toronto, on the 10th April, 1906, it was reported from Fort William that that city was obtaining electric power at \$15 per h.p., and the town of Orillia reported to the same meeting that its municipally owned hydro-electric plant was selling power to Orillia manufacturers at \$16 per h.p. per year.

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On the following day a deputation numbering nearly a thousand, and representing seventy municipalities from Sarnia on the west to Kingston on the east, waited on Premier Whitney urging Government action. The Premier said the difficulties were great but the Government was not frightened at this, and would undertake either the transmission of electricity or the control of the prices to be charged, so that the interest of the people should not be sacrificed.

A brake was already being prepared on the uncontrolled exploitation of Niagara power, for on the very day of this deputation's conference with the Ontario premier in Toronto, a bill was introduced in the United States Congress, known as the Burton Act, ostensibly for the preservation of the beauty of the Falls, but in reality to stop further diversions of water at the Falls until the United States and Canada might agree on a common policy. By this Act the import of power from Canada to the United States was prohibited, the prohibition not applying, however, to power already being transmitted or contracted for. From that time no new company has been allowed to alienate these international waters for private advantage, although numerous charters were taken out.

CHAPTER VII.

The Situation at Hamilton.

Brief reference was made in Chapter VI to the Cataract Power Co. (now the Dominion Power and Transmission Co.) of Hamilton. As early as 1897, this Company transmitted power from a point near DeCew's Falls to Hamilton, 35 miles. The installation consisted of only one penstock operating two units of 3,000 h.p. in all, but it was the greatest feat in long distance transmission at that period east of the Rocky Mountains, and required types of machinery not hitherto used. The highest voltage then used was 10,000, but this company raised it to 20,000 volts. Water drawn from the Welland Canal at Allanburg was at first carried by a viaduct over the Beaver Dam Creek, but by a happy thought of the engineer, 800 acres of land were purchased and converted at very small expense into a storage dam containing several small lakes, some of them 40 feet deep, and the power was then obtainable with a fall of 265 feet. This gave seven units, with a total of 52,000 horse power, and made one of the most economical installations on the continent. It was this advantage which enabled the company to give attractive prices to the citizens of Hamilton, Grimsby and other places, and yet make such profits as to enable it to acquire control of the light and power services of Hamilton, Brantford, Oakville, etc., and of the system of radial electric railways centring in Hamilton, some of which had been independently started with steam power. These amalgamations were the more easily accomplished as the men in one company were shareholders in the other companies. It was alleged that the Hamilton Cataract Power Co. could generate profitably at \$4.50 per h.p., and consequently it was

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hardly expected that the Commission could offer much advantage in prices to the citizens of Hamilton and Brantford, to which city the Hamilton Cataract Co. had also extended, obtaining a franchise for both the lighting and power service, and for the street railway and the electric line to Hamilton. The scope of this company's financial ramifications may be seen from the fact that, stage by stage, it obtained control of fourteen companies engaged in public utilities in and around the Niagara Peninsula, among which were: The Hamilton Electric Light and Power Co., The Hamilton Street Railway Co., Hamilton and Dundas Street Railway Co., Hamilton, Grimsby and Beamsville Electric Railway Co., Brantford and Hamilton Electric Railway Co., the Western Counties Electric Co. of Brantford; the Dundas Electric Railway Co., Lincoln Electric Light & Power Co. of St. Catharines, the Welland Electrical Co. of Welland, and the Hamilton Radial Electric Railway Co., extending to Oakville and originally designed to go through to Toronto. With the mastery of public services for these cities and towns, and the monopoly of primary power at such low costs, the company could have supplied Hamilton and Brantford at unprecedentedly low rates and yet have a good surplus. Yet when the Commission came into the field, the citizens of Hamilton were paying ten cents per kilowatt hour, the commercial users fifteen cents per kilowatt hour, besides a meter charge, and the city was charged \$84 per year for each arc lamp. No reduction was made till tenders were asked from the Commission, which estimated the cost of arc lamps at \$43 a year. Then the company dropped the price to \$47 a year, but fixed up a five-year contract with the city. Later the city asked for tenders for power for pumping and sewage, and when the Commission's tender was found to be \$17.50, compared with \$45 from the company, the latter came back with an offer to supply any municipality with service at ten per cent. below the rates of the Commission, whatever those rates might be.

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The logic of this experience was not lost upon the citizens of Hamilton, and in 1911 it was decided by vote of the ratepayers that when the contract with the company expired the city would get its power from the Commission and own its own distribution system. The sum of \$505,000 was voted for the purpose, and in the face of injunctions and other legal actions designed to thwart the new policy, the city hydro system was adopted in January, 1912. It began operations in 1913 with only five customers of all classes; now it has 15,450 customers for domestic lighting, 16,664 customers in the commercial class, and 530 customers for electric power.

In 1913 the Commission's charge for power in Hamilton was \$17 per annum; now it is \$14, and the rates for house lighting average a little less than 1 1-3 cents per kilowatt hour, with no meter charge, compared with 8 cents, plus 25 cents a month meter rent, which was charged by the private company just before the Commission's system was established.

CHAPTER VIII.

The Permanent Power Commission and its Constitution.

The result of discussions in the press, and of further educational campaigns of Hon. Adam Beck and many other public men, was that the Government determined to give the municipalities the opportunity they sought. Under authority of an Act of the legislature, a second commission, which became the permanent Hydro-Electric Power Commission of Ontario, was appointed in May, 1906. Hon. Adam Beck, head of the commission of 1905, was appointed chairman of this commission, the other members being Hon. John S. Hendrie (afterwards Lieutenant-Governor), and Cecil B. Smith, civil engineer. Owing to the demands of his professional business, Mr. Smith resigned a year afterwards, and his place was taken by the late W. K. McNaught, who remained a faithful member till his death.

The Hon. Isaac B. Lucas, who succeeded Sir John Hendrie, and who is, therefore, the oldest member, next to Sir Adam Beck, of the Commission as now constituted, is the son of a pioneer settler in Lambton County. He was born in 1867. After leaving Strathroy Collegiate Institute, he took up the study of law, became a barrister in 1889, and was made K.C. in 1908. He became head of the law firm of Lucas, Wright & McArdle, of Owen Sound and Markdale; also a partner in the legal firm of Mills, Raney & Co., of Toronto. He was elected to the Ontario Legislature in 1898 as member for Centre Grey, and was re-elected at five successive elections. He was appointed chairman of the Private Bills Committee in 1907 under the administration of Sir James Whitney, and continued such until the defeat of the Hearst administration. In 1909 Mr.

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Lucas became a member of the cabinet without portfolio. He was appointed Provincial Treasurer in 1912, and upon the death of Sir James Whitney he became Attorney-General in 1914. From 1914 to 1919 he had charge of hydro-electric legislation in the House, being from the first-named date the Government member of the Commission. In these years he piloted the hydro legislation through more than one crisis, and the *Montreal Gazette*, an opponent of public ownership, referred to him as "a man of unusual ability."

Colonel the Hon. Dougald Carmichael, now Government representative on the Commission, was one of the many new men who were returned in the election of 1919 to form the Farmer's Party and Labor Party in Ontario. After passing through the public school, he attended the Collegiate Institute at Collingwood, but his father, a Grey County farmer, died when Dougald was yet a lad. He was, therefore, not able to continue his education, but became a father to his younger brothers in the management of the farm. He remained on the farm till 1915, when he joined the Canadian army and went overseas as captain in the 58th Battalion. His brother, a physician, who joined at the same time, met death in the war. His only sister also joined as an army nurse. With his company he went into the trenches in 1916, and in the same year, during the third battle of Ypres, he was made a company commander. During the fighting around Cambrai he was made Colonel of the 116th Battalion. He received the M.C. for the part he took in the trench raids by the Canadians in February, 1917, and in the fighting in July of the same year was awarded a bar with the Military Cross. At Amiens he was awarded the D.S.O. and the bar was added to this in the last great battle of Cambrai. His name was frequently mentioned in the despatches. He was wounded at Amiens and again at Cambrai, both being hospital cases. Colonel Carmichael had the respect and affection of his men to an unusual degree, because of his

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fearlessness in leading in any situation of danger. He did not enter politics out of preference, but the name he had won during the war made him the natural choice of the farmers of his riding. Colonel Carmichael is looked upon as a man who will be careful in forming his judgments, and on this account and because of his industry and patience, he is regarded as a valuable addition to the Commission.

A brief biographical sketch of Sir Adam Beck appears in another chapter.

The first Power Commission Act of 1903 was considered unworkable, partly because it had the effect of encouraging the establishment of local commissions in such a loose way that their plans could not be brought into one unified scheme. The municipalities had not yet learned to pull together, and there were sectional jealousies and suspicions which required time and experience to overcome.

The substitute Act of 1906, passed by the new administration, was also an imperfect instrument for the work of the Commission, for the opponents of municipal ownership stirred up the councils and other interests to attack the validity of the by-laws under which the seven original municipalities entered the co-operative union. The Act was revised at the next session of the Legislature, the defective by-laws being specifically validated, and, after subsequent amendments, the Act of 1907 became the charter of the Power Commission.

The Act creates a body corporate under the name of "The Hydro-Electric Power Commission of Ontario," consisting of three commissioners, two of whom may be members, and one of whom shall be a member, of the Provincial Cabinet. The Lieutenant-Governor in council may appoint the chairman. Two members shall form a quorum. The commissioners hold office during pleasure, and the Lieutenant-Governor may make appointments to fill vacancies.



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The Commission has power to appoint its own engineers, officers, and staff of employees, and to fix their salaries, subject to ratification by the Lieutenant-Governor in Council.

The Commission may, by report to the Lieutenant-Governor in Council, designate any lands, waters or waterpowers, including the plant pertaining to such property, which in the opinion of the Commission should be acquired or leased; and on such report the Lieutenant-Governor may authorize the Commission to acquire by purchase, lease or otherwise; and to carry on such work for the transmission, supply and distribution of electrical power, entering upon private property or removing trees or other obstructions for such purposes; and may contract with any corporation or private person for the supply of electrical energy to the Commission. The procedure for exercising such powers shall be as under the Public Works Act.

When called upon by the Lieutenant-Governor in Council, the Commission shall investigate water powers and report as to their capacity and value, such report to be laid before the Legislative Assembly at its next session.

On the application of any municipal corporation for electrical power, the Commission shall furnish to the applicant a statement of the maximum price per horse power at which energy will be supplied, and an estimate of the cost of the transmission lines required, and may furnish plans and specifications, with estimates of cost for the necessary distribution works. The local municipality may then enter into a provisional contract with the Commission, but this contract shall not be binding till a by-law has been passed by the municipality, when a permanent contract may be made, after approval by the Lieutenant-Governor in Council. By-laws for raising money may be submitted at the same time as the by-law for the contract. The municipality is not restricted in its rights under the general municipal acts by reason of its contract with the Commission.

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A contracting municipality may, with the consent of the Commission, supply power to a person or corporation outside of its own bounds, if no objections are raised by the municipality affected.

The Commission may supply power to a railway or other corporation or person (using the railway right of way for the purpose), but any net profit under such contract shall be applied to the maintenance of the work of the Commission in general.

The cost of the work undertaken by the Commission for a municipality shall be repayable to the Commission.

The price per horse power payable by any municipality shall be the price of the power to the Commission at the point of development or of its delivery to the Commission, and the municipality shall pay its proportion of the following charges, as adjusted by the Commission: (a) Interest at 4 per cent. on money expended by the Commission in construction or purchase; (b) An annual sum sufficient to form in 30 or 40 years a sinking fund to retire the securities issued by the province under the Act; and (c) Line loss and cost of operation, supervision, repairs, renewals and insurance of works.

The Lieutenant-Governor in Council may raise by loan, on the credit of the province, the sums requisite for the purposes of the Act, such sums to be paid over to the Commission and accounted for and audited as in the management of the public accounts; the receipts by the Commission to be paid over to the Provincial Treasurer for the retirement of the securities.

Any complaint in writing from an individual or corporation that the rates charged under these contracts are unfair or excessive, may be made to the secretary of the Commission, and the matter of the complaint may be determined by the Commission, and such order given as meets the case, the commissioner-judge in such cases having authority as conferred

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under the "Act respecting Enquiries concerning Public Matters." The penalty for refusing to abide by the decision is \$100 a day.

The text of section 23 reads: "Without the consent of the Attorney-General no action shall be brought against the Commission or against any member thereof for anything done or omitted in the exercise of his office." Neither the Commission nor province is held liable for any error in estimates or specifications of work furnished by the Commission.

Further amending Acts have been made from year to year, as defects were revealed in operation. The Act of 1908 confirmed the contracts made with the Ontario Power Co. and authorized a form of contract between the Commission and the corporations acting under it. The Act of 1909 abated litigation attacking the by-laws and contracts, gave a municipality authority to act on a plebiscite instead of a by-law, and empowered the Commission to obtain easements to construct and maintain transmission lines. The Amending Act of 1910 conferred on the Commission the powers of "eminent domain," as possessed by railways, to take possession of land with or without the owners' consent, for the erection of transmission lines and works, claims for damage to be settled as provided by the Ontario Public Works Act. Amendments of 1911 enabled persons outside the contracting municipalities to obtain electric power from the Commission direct without a general contract from the municipality, on payment of the cost by the applicant. Another amending Act of the same year gives the Commission authority to decide upon the use of highways by more than one corporation, private company or individual, for erecting lines or works, and the Commission may define the conditions necessary to prevent injury resulting from construction of such works, the initiating corporation to be at the expense of such works, and provision for arbitration to be as under The Municipal Act. Nothing done by the Commission under this

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amending Act shall be open to question or review in any court; and no court shall have authority to grant an injunction or other restraining order hindering the construction or operation of any works, the location and mode of building which have been carried out as approved by the Commission. The Act of 1912 made it more clear that powers of eminent domain shall be conferred on the Commission should it desire to enter on or take possession of any lands on which a water power privilege is situated, and to construct any works for power, or to flood lands if necessary, to build storage dams, and such powers may be exercised through a local municipality with whom the Commission has a contract. In the same connection the Commission takes power to expropriate an existing plant or machinery for the supply of electric power. The Commission may take temporary possession of land for survey or other purposes but abandon it within three months, claims for damages arising out of the occupation to be determined as under the Public Works Act.

The rates chargeable by any municipality shall be subject to the approval and control of the Commission, as shall also be the rates chargeable by any individual or company receiving electrical power from the Commission. The Commission may prescribe a system of bookkeeping for the municipalities, and call for such returns as may be needed by the Commission for publication. Should there be a surplus to the credit of a municipality in its electrical operations, after providing for interest and debentures, the Commission may direct that this surplus be used: (a) For the reduction of its debt incurred in construction; or (b) in maintenance, repairs or renewals; or (c) extension of works and plant; or (d) the formation of a fund for future contingencies. The penalty for non-compliance with the orders of the Commission is a fine of \$100 a day. The Commission has power to order overhead wires to be placed underground; and several companies may be ordered to use a conduit in common in making such changes. Where lines

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are being constructed under authority of the Board of Railway Commissioners of Canada (Dominion) the two commissions may jointly prescribe conditions and regulate the work.

In 1914 an Act amending the Power Commission Act was passed by which rural municipalities could get the benefits of hydro-electric power. This was done by a provision that where a majority of the freeholders of a township (rural municipality) desire it they may by petition ask the Commission to take proceedings for lighting the roads or streets, the township clerk to certify that the petition is signed by a majority according to the last assessment roll. When the township council has acted on the petition, the Commission prepares an estimate of the cost. Within one month petitioners may withdraw their names, and if such withdrawals leave the remaining petitioners in a minority, no further steps are to be taken. Otherwise the contract with the Commission is authorized by by-law and the general proceedings follow those of other municipalities, except that the debentures are for twenty years, and are to be covered by a special annual rate on the taxable property within the area described in the petition.

By the Act of 1915, it is declared that no member or officer of any Commission appointed under the Power Commission Act shall hold stock or be financially interested in any way in any company or individual engaged in the electrical power or transmission business, or dealing in any electrical machine, appliance or process.

In the amending Act of 1916, provision was made for the appointment of a new officer to supervise the financial affairs of the Commission. He is called the Comptroller, and fulfils duties corresponding to those of the Provincial Treasurer or of the Federal Minister of Finance, even to the preparation of the "budget" or estimates for the ensuing year. He reports annually on the amount and character of the assets and liabilities, presents statements of the revenues, expenses of operation

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and any other matters of public interest in connection with the finances of the Commission. The Commission's accounts are also to be audited, either by the Provincial Auditor or an auditor appointed by the Lieutenant-Governor in Council.

The chief amendment passed in 1917, makes the Commission's lands liable for municipal and school taxes at the average value of lands in the locality, but exempts the Commission's buildings and works. A municipal corporation having a contract with the Commission may not pass a by-law for extension without the consent of the Commission.

Amendments passed in 1918 provided for the better co-ordination of the accounts of municipalities and the Commission with the approval of the Lieutenant-Governor in Council, is given power to borrow money upon its bond and debenture issues, the Commission paying to the Provincial Treasurer interest on such loans. The Commission may divert power from one of its systems to another, the costs of such diversion being adjusted between the municipalities of the systems affected. This is to enable one system to help out another in whose territory a shortage may occur.

The latest amendment to the Hydro Act, passed at the session of 1920, gives the Commission power to acquire or build power plants whose source of energy may be coal, oil or any other kind of power. Another clause enables the Commission to supply power from its own plants to individuals in advance of the formal order in council required. Where an appropriation made by the legislature for new work under control of the Commission is exhausted, the Commission is enabled to apply for special warrant for the amount needed to finish the work. The system of empowering a group of rural municipalities to co-operate in making a contract, where one district alone is unable to undertake it, is amplified by another new section. In such cases the rates and payments are left to the equitable adjustment of the Commission, which takes

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power to collect the rates, and to manage the distribution and supply.

The Electrical Development Co. has for years been taking from the Niagara River more water than it was entitled to under the agreement with the Park Commissioners, limiting the company to 125,000 h.p., but the company denied that it was exceeding its agreement, and has refused to pay for the excess power it was charged with taking. The Ontario Government referred the question to a bench of three judges of the High Court to ascertain the facts. The judges, in a report in 1918, found it to be a fact that the Company was diverting more water and generating more power than permitted under the agreement, and held that the excess power be delivered to the Power Commission at the price of \$9 per horse power per year. The Company refused to acknowledge the jurisdiction of the court. Then the Park Commissioners, on behalf of the Government, obtained an injunction restraining the Company from taking more water than required to generate 125,000 h.p. It happened that in the same year the Dominion Government appointed Sir Henry Drayton of the Railway Commission, as Power Controller for war-time purposes. One of the first acts of the Power Controller was to give an order to the Company to go ahead and generate as much power as it could, no restriction being imposed as to the price. This had the effect of nullifying the injunction, but with the cessation of the war the Federal Government power control was abandoned and the injunction revived. Application was then made by the Company for a stay of the injunction, and Mr. Justice Ferguson granted the stay on condition that the Company pay a nominal price of \$6 per h.p. year for the excess power used. To end these confusions, an Act was passed at the last session of the Legislature declaring that where an owner is developing power by diverting more water or using more power than its agreement calls for, the charter of the company or person may be revoked upon stated notice and the passing of an order in council.

CHAPTER IX.

Development and Organization.

An outline of the constitution of the Hydro-Electric Power Commission having been given, a few notes on its practical working will be of interest.

When a city, town, village or rural municipality wishes to participate in the benefits of the hydro-electric system, the first step is to ask the Commission for information on the cost of a local distribution system with the cost of a connection with the Commission's lines. The Commission sends its engineers to report upon such costs. If the applying council considers that its electors would be benefited by the service, a by-law setting forth the cost and conditions is prepared and a vote is taken thereon. If this vote is favorable then a second vote is taken on a by-law to provide the money. Upon voting the money the Commission makes a contract with the municipality. There is no term set for this contract. Practically it is a union from which there is no divorce. These conditions are well known to the applicants, and the facts, costs and requirements, including the liability of the municipality for its own share of the undertaking, are set before the electors. The Commission is proud of the stamp of men on its executive staff, for they have never underestimated the costs prepared for a municipality seeking to enter the union.

As a matter of security for the municipality's investment, the Commission stands at the back of the municipality and the province stands at the back of the Commission. There is no revenue to the province other than the rentals it derives from leases of water powers such as those of Niagara; yet in actual operation the province faces no liability, for the individual power and light users are charged an amount sufficient

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not only to cover the cost of the service, but to provide a sinking fund which will in thirty or forty years, as the case may be, leave each constituent as the owner of its own plant, and a working partner in a state-wide resource unhandicapped by the surtax of any private profit. So far not a single municipality has ever had a fraction of a mill in taxes on this account. The Commission, however, has no power to spend money or undertake any new construction without an order in council from the Provincial Government.

Though the Commission has wide powers such as those for expropriation of private property, and the authority to inspect and regulate municipal or private systems in the province, it exercises these powers with restraint. Its policy is to acquire by purchase or lease existing local systems, whether publicly or privately owned, to remodel these in harmony with its own by removing obnoxious poles and dangerously placed wires, and, by avoiding unnecessary duplication, secure economy of administration.

The executive work of the Commission has been incidentally of benefit to municipalities outside of the electrical sphere, for the staff has given advice and suggestions regarding water-works, gas works and sewage disposal systems, as related to power supply; while the accounting departments of the rural and village municipalities, which in time past have brought trouble and loss through lack of system, have been so remodelled by the Commission's experts as to become the standard for corporations outside the Commission's territory. In some cases the Commission acts as consulting engineers for its constituent corporations.

When a question of developing a new water power arises the cost of the investigation is paid for by the government, but when the work of developing is taken in hand these preliminary costs are transferred to the Commission and become a part of the capital cost of the work.

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The acquisition of the Central Ontario System along the Trent Valley was, however, obtained by negotiation with the Ontario government. This was explained as follows by Sir Adam Beck.

"The provincial government bought and placed under the control of the Commission what was known as the Electric Power Company System in the Central Ontario district. This company was under the control of the Sun Life Insurance Company. We bought out twenty-two subsidiary companies with this concern for \$8,350,000. This corporation owned gas companies, waterworks, street railways, pulp mills and electric plants. The generating plants were located on the Trent Canal. These water powers are under Federal jurisdiction, and the Dominion government granted leases to this company from time to time. The company bought all the riparian rights on the canal, and therefore secure nearly all of the leases. We were obliged by negotiation, and at their price in a sense, to buy out this company. Since we have taken possession we have reduced the electric rates from time to time. We have a very comfortable surplus and have nearly doubled the capacity of the plants, and the sale of power."

The provincial government in buying out the company acquired the water licenses granted by the Dominion government, and it was found that these varied from 50 cts. to \$1.50 per h.p. per annum, though why such discrimination should exist is not apparent. The Commission, in taking over the administration of the system found more or less variation in rates charged to individual customers, there being many favored with low rates at the expense of their neighbors. These preferences were ended under Commission control, and the same rates for the same service are now charged in every municipality.

In cities of 100,000 or more the business may be operated under a civic commission, instead of by the municipal council.

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The working of these commissions is illustrated in the chapters on the city of Toronto.

At the beginning the Commission purchased all its supplies from dealers and manufacturers, but as its operations grew it was found convenient and more economical to obtain lamps and other equipment in large quantities and supply the municipalities out of its stock more cheaply than they could buy for themselves. By this method the Commission buys lamps by the half million and has become an important customer for large manufacturers.

The executive of the Commission consists of the board of three members, already named, with Major W. W. Pope, general secretary; Mr. Frederick A. Gaby, chief engineer; and Mr. J. W. Gilmour, treasurer. There are four divisions of work: legal, engineering, accounting and inspection. The engineering department has branches which include hydraulic engineering, electrical, railway and general engineering, laboratory work, municipal operations, and purchasing and estimating. Applications for power are made through the secretary and are then taken up by the engineering department.

The Commission has 2,000 miles of private wires by which it keeps in touch by telephone with the operations of the twenty water powers and the generating, transforming and distributing plants of the twelve systems under its control.

The Commission publishes a monthly magazine called "The Bulletin." Its aim is to provide the municipalities with a source of information regarding the activities of the Commission, to provide a medium through which matters of common concern may be discussed and to promote a spirit of co-operation between Hydro municipalities. It is well illustrated and its articles and reports are instructive.

The Commission's offices have grown as a consequence of the work to be done. When first organized, a couple of offices in Toronto Street, opposite the Post Office sufficed for the staff

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TO THE
HONORABLE
MEMBERS OF THE
HOUSE OF REPRESENTATIVES

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of four or five. Then a suite of offices in the Continental Life Building was taken, pending the erection of the present headquarters, shown in the illustration. Since then, several private residences in the rear of the headquarters building have been turned into offices to provide for staff, which has outgrown the capacity of the new building. A new four-storey annex has also been acquired for administration purposes near the main building.

For twelve years the members of the Commission gave their services free, but as the labor and responsibility grew, such a method could not be continued and the government voted \$4,000 a year to the two commissioners and \$6,000 to the Chairman, the allowance to the Chairman being now increased by an additional \$6,000. The Commission has its own civil service. The provincial government has wisely refrained from all interference with appointments to the Commission's staff. Consequently party politics has had no place in the system, and appointments are made on the merits of the applicants. The Commission has refused to allow itself to become the dumping ground of incapables. Its policy has been rather to seek men of ability wherever they may be found. Both sexes are eligible for office or laboratory work, but men only have been assigned to out-of-door operations. The Commission is proud of the loyalty and character of the great majority of its servants in all departments. In the sphere of economy of cost to the public the Hydro-Electric Power Commission has beaten every private company that measures its success by the dividends it draws from the public; in the realm of efficiency the boast of the private companies is equally vain when compared with the record of the Commission.

So far as the territory served by Niagara power is concerned the history of the Hydro-Electric Power Commission has been one of continuous progress, and this progress has neither been forced nor haphazard. Even at the beginning the Niagara

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division of the Commission's undertakings constituted the largest hydro-electric distribution system then in existence. Eleven other systems have been added since then, and all these when combined still form the largest electrical generating and distribution system in the world, both as regards the amount of energy produced and the area over which it is distributed. The total energy now used is 315,000 horse power, exclusive of the new Chippewa plant now being built on the Niagara which will have an initial capacity of 300,000 horse power and an ultimate capacity of a million horse power. Add to these the Ranney's Falls plant now under construction, yielding 10,000 horse power, and the new Nipigon power site, producing 30,000 horse power and having an ultimate capacity of 75,000 horse power, and we have an aggregate of 1,400,000 horse power produced within the next two or three years perhaps, making by far the largest system of hydro-electric energy in the world. The area over which the power is transmitted extends from the Ottawa Valley on the east to the Detroit River on the west, and from the shores of Lakes Erie and Ontario on the south to the regions north of Lake Superior. It is to be understood that in sections such as New Ontario settlement is for the present limited to narrow strips of territory, yet the water power developments are often in themselves the pioneers of colonization and the creators of new industries. Since the first general survey under Cecil B. Smith, there has been a re-division of the water power areas into twelve systems, brought about by the calls for the Commission's services and by the opportunities for purchasing local generating plants. As a commentary on the charge that the Hydro-Electric Commission was being erected into a system of confiscation of private capital it is well to note that in all these extensions the Commission has not yet had occasion to expropriate the lands, waters or other property of private companies—though having the most ample legal right to do so—but it and its constituent muni-

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cipalities have acquired no less than eighty-six generating or distributing plants by negotiation. Not one of these local plants has been purchased direct from the Crown, but the crown rights which never should have been alienated have been recovered by negotiation in the interests of the public. The new plant at Chippewa and that at Lake Nipigon, however, involve crown rights.

There are now 181 municipalities in the twelve systems, and these include incorporated cities, towns and villages, and townships (or rural municipalities) of which last there are thirty-three. Besides these there are numbers of other municipalities who have made contracts with the Commission but for various reasons cannot arrange for equipment, and there are others on the "waiting list" unable to get power in this time of shortage. Of actual and prospective municipalities that may be counted in the movement there are over 250.

If space permitted it would be interesting to trace the history of hydro-electric power in the various cities, towns and townships, with the attendant multiplication of the comforts of life among the people and the growth of industrial facilities which have made Ontario the largest manufacturing province of Canada. At present it is only possible to comment on the general results, and cite only such cases as will signify the dangers that had to be faced and the obstacles overcome before it could be felt that the Hydro-Electric Commission represented a permanent public policy.

The first and most patent effect of the municipally owned systems under the Commission was the reduction of the rates before charged to householders for lighting, etc., and to manufacturers for motive power. Power is carried from Niagara to Windsor a distance of 250 miles, and in Windsor, which has a population of 25,000 the rates are calculated to be 40 per cent. lower than in Detroit, Michigan, just across the boundary river, though Detroit has now a million inhabitants. Before

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the Commission bought the distribution system at Ottawa, the citizens of the capital were paying 15 cts. net per kilowatt hour for lighting and \$40 and upwards per horse power; after the purchase the rates for lighting were reduced one-half and for power to \$25. Yet dividends of 5 per cent. were paid on the stock of the generating company, and in 1908 there was a net profit of \$17,000. Rates in Ottawa have since been further reduced. In accomplishing this the Commission had the satisfaction of settling a long and acute quarrel between the company and the cities of Ottawa and Hull. In Port Arthur there was a controversy between that city and the Kaministiquia Power Co. which was also settled by the mediation of the Commission to the satisfaction of both sides and to the cheapening of the service to the citizens. The results at Hamilton and Toronto are described elsewhere. At St. Thomas, 120 miles, and Galt, 89 miles, from Niagara, the rates for lighting and power are one-half of those in Buffalo which gets its power through a private company only eighteen miles distant from Niagara, when measured from the station of the Canadian Niagara Power Co., Buffalo's chief source. At Kitchener (then Berlin) previous to the days of the Hydro when that city was served by a steam plant the domestic rate was 11 cts. per K.W. hour with a charge of 25 cts. a month for rent of meter; the present rate averages $3\frac{1}{2}$ cts. per K.W. hour with no meter rent. These typical cases are sufficient to show the effect of the advent of the Hydro-Electric Commission on the cost of power to manufacturers and to the citizens at large. It is true that the private companies have reduced their rates but these reductions were not in evidence till the policy of the Hydro was put into effect. Such reductions as were made were therefore to be credited to the Hydro. Accepting as a fact the monopolistic character of the Commission's activities, there has been an essential difference between a monopoly created to give the communities a service at or near its cost, and one created with

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the opportunity of using the surplus to increase the toll taken for private profits. This was illustrated in the case of Montreal where as soon as a competing company was put out of business, the power and lighting company raised the rates from 10 cts. to $14\frac{1}{4}$ cts. per kilowatt hour, unless the customer was willing to be tied down to a five year contract and then it was $12\frac{3}{4}$ cts. The rates for power were also jumped from \$50 per h.p. per year to a price varying from \$95 to \$120.

As before mentioned, the rates, after providing for the ultimate extinction of the construction cost, are based on the actual cost of the service; therefore, whatever the changes required by the present high cost of living and rates of wages, the effects will not be worse upon the Commission's work than upon that of any private company. Being based on actual cost the charges to the municipalities are adjusted each year and the following are a few examples taken at random of the results in the seven-year period from 1912 to 1919, the first named figures showing the prices charged per year per horse power for 1912 and the second for 1919: Toronto, \$18.50-\$14.50; London, \$28-\$19; St. Thomas, \$32-\$24; Ottawa, \$15-\$14; Guelph, \$25-\$19; Hamilton, \$17-\$14; Waterloo, \$26-\$20; St. Mary's, \$38-\$28. Except in the case of new corporations entering the system there has hardly been a case in which rates have not been reduced. As the general load of power increases the cost of delivery tends to become less, and this in most cases has more than counterbalanced the increased cost of wages and material since the war. In some instances the credit balances due to the municipalities now amount to nearly the original cost of the local plant, so that this cost instead of being wiped out in thirty years may be extinguished in fifteen years or less. The town of Barrie has this year freed itself entirely from the debenture debt and all its system will now cost the town will be the amount of maintenance and repairs. The total of these surpluses and reserves amounted in 1919 to

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\$7,206,712, and they accumulated in the face of the reduction of rates. These balances are held to provide for contingencies and betterments and may be taken as evidence of conservatism in financing. Public confidence has been gained also by such facts as this, that the Provincial Treasurer at the time of construction was assured by unfriendly sources of information that the first transmission system from Niagara Falls would cost \$12,000,000; the Commission's engineer estimated \$4,000,000 and the actual cost to the twelve participating municipalities proved to be several hundred thousand dollars less than the engineer's estimate. Further reference to recent financial operations will be found in Chapter XIX.

The surpluses mentioned are being re-invested in the plants, so that none of the money or the credits associated with the funds can be taken out of the systems. For example, the city of London in 1917, after paying all charges and keeping its plant in first class condition had a surplus of \$76,000 on an original investment of \$750,000. Because of the extensions and improvements in past years the London plant to-day has a value of \$1,200,000. Over a third of this plant is now free of sinking fund and interest charges and is only subject to maintenance and operation charges. Now, a private corporation would have dealt with this situation by issuing new stock to the amount of from half a million to a million and a half dollars and the people whose earnings were the sole source of this surplus would find their own assets turned into a liability and funded against themselves. Stripped of the intricacies of joint stock finance, this is the difference between a public service tax collected solely in the interests of the people who pay the taxes and the modern survival of the Roman system by which the government raised its revenues through tax "farmers" leaving the publicans who collected them to take their toll from overcharges.

CHAPTER X.

Evolution of the Electric Power Federation.

Having outlined the legislative history of the Commission we return to the story of long distance transmission by the Ontario municipalities co-operating under the ægis of the Hydro-Electric Power Commission.

Those interested in the perpetuation of private company control of public services predicted terrible disaster should any public body attempt to control the natural resources, such as the water powers and electric energy, which most intimately affected the life of the people. It was argued—and the arguments advanced were covered by a heavy artillery barrage from technical experts—that electric power could not be developed or transmitted at the prices or under the conditions calculated by the Commission, and that, even if it could, the municipalities could not manage their own affairs, but would end in financial collapse. It will be found that the predicted disasters have not happened, that the municipalities have administered their trust to the satisfaction of the people whom they represent, and that in the main the calculations of the Commission's engineers have been more than fulfilled in actual execution.

We must not forget that before the era of electrical transmission the water powers of Canada and the United States were considered to be the property of any mill owner who chose to buy the surrounding land, install a water wheel and operate a lumber mill, flour mill or woolen mill; and if the mill site developed into a village or town any public power service was his inheritance. That nature's resources, upon which the whole community thrived and without which it would famish, should be regarded as the natural right of the com-

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munity had not yet become a common conviction. We should recall that at the time the Hydro-Electric Commission was preparing plans for its transmission system from Niagara Falls, developments were provided for on the Canadian side of over 400,000 horse power while as yet the actual demand for power amounted to less than 50,000 horse power within transmissible distance in Ontario and the total demand on both sides of the river for Canadian power was less than one-fifth of the power provided for. At this period the great electro-chemical and electro-metallurgical works, many of which were the direct offspring of hydro-electric power and consume energy by thousands of horse power, were in the infantile stage and no one could have anticipated that by 1920 there would be such a famine of power that these processes alone would consume all the energy now available at Niagara Falls. It is only by keeping these facts in mind that one can give proper credit to the foresight and courage of the pioneer companies whose engineers and electricians planned and adapted untried machinery for the industries yet to be. The recognition of this courage was no doubt in great part the reason why the Commission decided for the time to defer any power developments of its own at the Falls and purchase power ready to hand from one of the private companies.

At this time a company called the Niagara, Lockport and Ontario Power Co., was getting ready to do in New York State, under private auspices, what the Commission was planning to do in Ontario under municipal ownership. The American company had barely organized and built its transmission lines to the cities of Rochester and Syracuse before Niagara power became an international question and a stop was put to further private power developments. Before the export of power to the United States had been limited by the United States Government the American company had bargained for 35,000 h.p. out of a total of 52,000 h.p. which the Ontario Power Co. of Canada

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was getting ready to produce, but when the ultimate capacity of 180,000 h.p. would be available the Ontario Power Co. would be anxious for customers, especially after the export of power to the United States was prohibited. The Ontario Power Co. was therefore disposed to make a close bargain with a purchaser so large as the Commission might prove to be, and after careful negotiations a thirty-year contract was made with the Commission. By this contract the Commission was to take power from this company in blocks of a thousand horse power, starting with a minimum of 8,000 h.p. until a total of 30,000 h.p. should be used, the term of purchase to be for a period of ten years, renewable at the Commission's option by ten year periods till 1950, the Commission reserving the right to expropriate the plant in the meantime. The price was to be \$10.40 per h.p. per year for any amount up to 25,000 h.p. and \$10 per horse-power for amounts exceeding 25,000 h.p., the company binding itself to furnish a total of 100,000 h.p. upon notice of demand. It was intended at first that power should be transmitted from Niagara Falls to the various stations at 60,000 volts, but research showed that it could be more economically sent at 110,000 volts, and in 1908 the agreement was revised, the Commission agreeing to take from the company exclusively up to 30,000 h.p. and thereafter one-half of its total requirements up to 100,000 h.p. The price was now to be \$9.40 per h.p. per annum for amounts up to 25,000 and \$9 per h.p. if the amount exceeded 25,000 h.p. The power was to be supplied at these prices for the whole twenty-four hours of the day. The contract was considered to be very satisfactory to the Ontario Power Co., as it would take up the whole output of the plant without hunting for small customers, and the fact of the bargain furnished proof of itself that the Commission was not bent on destroying capital or ruining a reasonably conducted private business.

The Commission afterwards removed all questions between

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itself and the Ontario Co. by the purchase of the company's plant and assets, under the following circumstances as described by Sir Adam Beck in his statement before the congressional committee at Washington:

"The plant was offered for sale and we were approached to purchase it. We had a contract with the company for 100,000 h.p. The total installed capacity of the plant was 165,000 h.p. Their charter rights were for 180,000 h.p. They maintained that they had the right to install another 18-foot pipe line, and because this right was contested by the Province, they said, 'If we cannot go on with it we shall sell.' Negotiations were entered into, and the Hydro-Electric Power Commission acquired the plant and took possession after about a year's negotiation. The remaining 60,000 h.p. of capacity is under contract to the Niagara-Lockport Company. We assumed the whole of the bonded indebtedness of the company, amounting to about \$14,000,000. We acquired the common stock of the company and paid them \$8,000,000 in forty-year Hydro-Electric Power Commission 4 per cent. bonds, guaranteed by the Province of Ontario. The purchase included a transformer station and a short system of lines in the immediate vicinity of the plant itself. During the first year of operation we reduced the cost of operation by over \$40,000. The revenue from our two firm contracts, one with the municipalities, and one with the Niagara-Lockport Company, expiring in 1950, will be sufficient to maintain the plant at the highest point of efficiency, provide for renewal and depreciation charges and operation, and at the same time accumulate sufficient revenue to retire the whole of the debt in twenty-five years. That is, instead of the Ontario Power Company owning this plant in twenty-five years, we will, out of the reserves we are setting aside, pay off the whole of our indebtedness, and own the plant free of debt in twenty-five years. More than that, when the time comes that more water is essential, we

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can take the ten or twelve thousand cubic feet per second of water now being used comparatively inefficiently in the Ontario Power Company plant, and use it in connection with our Queenston-Chippewa scheme, thus securing the advantage of the full head available between the two lakes."

The Commission's decision to defer the construction of its own power plant at Niagara Falls proved a wise one. By confining itself to distribution at the start much less capital was required and still the municipalities could be protected from exorbitant prices. In order not to impose too great a strain on the few municipalities then committed to the policy, even the distribution systems were narrowed to primary requirements at the start.

Though only seven municipalities were parties to the original undertaking yet by 1908 the following fourteen municipalities had passed by-laws by large majorities in favor of taking power through the Commission: Toronto, London, Stratford, St. Thomas, Berlin, Guelph, Galt, Woodstock, St. Mary's, Waterloo, Preston, Hespeler, New Hamburg and Ingersoll. The ratepayers of Ingersoll had defeated the by-law on the ground of cost, but shortly afterwards made a contract with the Commission. The total amount of power called for in these undertakings was 26,235 h.p. The prices were based upon the amount of power each constituency purchased and varied also according to cost at the distance transmitted. The highest was \$29.50 per h.p. per year and the lowest, that of Toronto, \$18.10. The main elements of the plan of rate fixing were: 1st, The contract price of power from the Ontario Power Co. at Niagara Falls; 2nd, A charge of 4 per cent. per annum on that part of the construction cost applicable to each municipality; 3rd, An annual charge sufficient to create a sinking fund which in thirty years should completely cover that part of construction cost chargeable to each municipality, and 4th, That part of the line loss and operating and maintenance charges applicable to

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each municipality. Each municipality provided its own local distribution system, and charged its manufacturers and householders prices which would cover the cost of its home distribution added to the assessment for power from the Commission. Except in the case of Hamilton, which had the advantage of the most economically produced power supply on the continent, the rates paid by these municipalities were lower than they had been receiving from any of the private companies. When the co-operating bodies were considered as one the rates averaged \$22 per horse-power per year, as against an average of about \$60 if all the power had been generated by steam, which was the power source in every place except Hamilton.

Regarding the use of hydraulic power as a concern of the province at large and not the monopoly of the site on which it is produced, one important principle applied for the first time in hydro-electric economy was equality of the right to power in all areas within range of the current. Both Sir Adam Beck and Sir James Whitney conceived of this newly revealed energy, not as the privilege of the man who, by obtaining a place in the Sun, here at the seat of power, would keep the surrounding community sitting forever in his shadow, but as giving all citizens, as far as possible, the right to their share of nature's resources. That Sir Adam Beck clearly foresaw the benefits of this enlarged freedom will be seen by the following extract from an address he made at the first annual meeting of the Commission of Conservation at Ottawa in 1910: "Had this matter (power privileges) been left exclusively in the hands of private companies, their tendency would have been to get the easiest market for their output by inducing manufacturers to settle within easy distance of Niagara Falls, offering large blocks of power to large users. Under the policy of the Commission the benefits are being distributed throughout the province to large and small users alike, thus contributing to a

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well balanced and general development, rather than an abnormal expansion of one district at the expense of others."

Rights of way for the power lines were secured, contracts were let, and in the last two months of 1910 current was sent over the Commission's own lines to the following seven municipalities, in the order of their greatest distance: London, Stratford, Woodstock, Waterloo, Berlin, Preston and Guelph. Out of a total of 11,985 h.p. allotted to these seven, only Berlin was able to take at once the full allotment of the power contracted for. As Berlin had been the place of the first informal convention of municipalities it was fitting that the formal turning on of the first power should take place here, which ceremony was performed by Sir James Whitney, October 11th, 1910, at a public meeting followed by an electrical illumination of the town, and a dinner at which some of the food was cooked in electric ovens.

CHAPTER XI.

Toronto's Struggle for Self Government—The Power and Lighting Problem.

The situation of Paris or Verdun during the great war did not more truly determine the issue with Germany than did that of Toronto on the power problem during the formative years of the Hydro-Electric Commission. In vain would other Ontario cities have raised the cry "they shall not pass," if Toronto had surrendered to the trained hosts that knew so well how to use the public revenues to defeat public control. If Toronto had fallen, as Paris did in the first war with Germany, generations would probably have passed before the municipalities would have recovered the control of their own civic functions, and then only after wiping out the entail founded on the system of public taxation for private profit.

At the time Toronto was considering the establishment of a distribution system for electric power the Toronto Electric Light Co. had bought off or killed off all opposition and held a monopoly of electric lighting and power in the city. It had started business as an arc lighting company and, in its agreement with the city, undertook to lay its wires underground and not to amalgamate with any other company. It respected these conditions by absorbing the business of an incandescent lighting concern and so getting the use of the incandescent concern's overhead wires. The city, instead of stopping the violation of the agreement, allowed time to pass, during which the company extended its overhead wires. It was only in 1911 that the city brought action and not until 1916 did the case reach a decision in the Privy Council upholding Toronto's contention, but even then only in respect to those areas since annexed to the city.

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When the company was organized in 1883 it had a paid-up capital of \$175,000, and in 1907, after twenty-four years, had an authorized capital of \$4,000,000, with a yearly income of \$1,039,716 and a clear profit of \$387,790. Its dividend was 8 per cent., and, allowing for the reserves which it was laying by, it was earning 13 per cent. per year. In 1889 it had secured a thirty years' contract with the city, renewable for further periods of twenty years in the event of the city not purchasing. The company had started operations with a steam plant, the cost of generating being at the time \$55 to \$60 per year per horse-power, but about 1906 was receiving power from the Electrical Development Co. at Niagara Falls, over the lines of the Toronto and Niagara Power Co., with both of which it was affiliated by shares held in common and by interlocking directorates. The same group were in control of the Toronto Street Railway Co., as well as of the company holding franchises for the radial railways reaching east, west and north of the city. Interlocked with these was a holding company known as the Toronto Power Co., which had acquired rights, the exercise or lapse of which might have the effect of avoiding some of its obligations to the city. The Toronto Electric Light Co., besides a rapidly growing power and lighting business, had the latent influence of several hundred city shareholders numbering men in high social and business positions, loan and financial companies and philanthropic organizations. Its influence had been strong enough to defeat a by-law submitted in 1895 to establish a civic lighting plant, and an attempt made in 1897 to get fresh estimates had come to nothing. In 1900 when the report of the Toronto Board of Trade, before referred to, stirred public interest another ineffective attempt was made for action by the city council. Public discussion, however, was accomplishing something, and the press on the whole was favorable to municipal operation or ownership, or both, of electrical distribution systems.

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Each of these companies obtained investors who put their money in, expecting profit, so that omitting the holding company here was a system providing four stages of profit-taking, in each of which the profits would come from the consuming public. Four toll gates were erected between the people and the source of power.

With such a combination of financial, transportation and other interests arrayed against it, and with the opposition in the Legislature seeking to embarrass the Government, it seemed a forlorn hope to establish any public service under municipal ownership. When at last the Commission was able to offer Toronto an estimated rate of \$17.75 per horse-power per year the manager of the lighting company authorized the statement that they had a rate with the Electrical Development Co. which would enable them to supply the city at \$8.75 and would only require the city to pay for the power it used. In the hope of reaching an agreement for taking over the company's plant and transmission lines negotiations were started by the Government, but drifted along while preparations were being made for the transmission lines from Niagara to Toronto. The hand of the franchise holder was meantime felt in Toronto from many unexpected quarters. No doubt the affiliated interests chuckled when the Grand Trunk Railway Co., for purposes of its own, stepped in and expropriated enough land in the environs of Toronto to block the transmission line. An appeal was made to Ottawa but the Dominion Railway Commissioners upheld the railway company, thus causing months of delay, till another route of entry was found along the lake front.

Articles appeared in some of the journals friendly to the private interests warning the public of the menace to life from the untried high voltage, and to further advertise these warnings agents went out along sections of the line from Niagara inciting the farmers and others to ask high prices for the right of way and to bring actions for damages against the city and the



Aeroplane view of the Queenston-Chippawa Power Canal under construction.



Silo-filling with Hydro Power.

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Commission. Adroit endeavors were made in the same papers to convince the public that if Toronto wished to own its own services a producer-gas plant would be the best source of power. The affiliated companies did not themselves act on this belief in producer gas. The Toronto and Niagara Power Co. had obtained an 80 ft. right of way from Toronto to the Falls, ample to provide not only for all transmission towers, but enough space for a double track high speed railway which would give a new connection with New York and round out the radial lines by which they would become masters of the suburban traffic with Toronto. At the Niagara end they had bought 530 acres of land along the Chippawa stream upon which they could build industries that would consolidate their production interests.

Knowing with what veneration the Imperial Privy Council upheld vested interests it was hardly to be wondered at that the offers made by the city to take over the plant of the Toronto Electric Light Co. were rejected rather light-heartedly. The directors of that company no doubt thought they had correctly taken the measure of the city council, for they had some years before this induced the city assessor to become the general manager of the Street Railway Company. This gentleman, had been for years an alderman and for four years was Mayor during a time of controversy with the Company. No other tried servant of the city possessed so much of the kind of information these companies wanted as he.

At a conference in 1908 between a committee of the city council and the directors of the lighting company to discuss terms of sale it appeared to the city's representatives that the company was disposed to deal only on the basis of a capitalization of its future prospects calculated on its existing high rates. "We are not before you to offer our property for sale," jauntily declared the company's legal counsel at this conference, "rather the city is in the market as a buyer. It is impossible

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to make an offer when as a matter of fact the property is not for sale." He boasted of having a contract which, if not annulled by the city's purchase on the company's terms, would be perpetual, and having already 9,000 customers for power and light, they were prepared to meet the city's competition, being sure that most of their customers would remain with the company. Moreover, the company had such a good contract with the Electrical Development Co.—though he declined to disclose the figures—that they could afford to reduce the rates at once by 20 per cent. and still have a profit.

After long discussion the city offered to pay \$125 per \$100. The Company would accept no less than \$160, and the city went no further towards purchase. In 1919 the stock was quoted at about \$44.

The city council had approved the provincial hydro-electric policy in 1907; legislation authorizing the city to make a contract passed in the same year, and in 1908 the council submitted a by-law to spend \$2,750,000 in building a distribution plant, and the by-law was carried by a majority of 15,048 to 4,551. The first installation of the Toronto plant was sufficient for 10,000 h.p., it being understood that extensions would be made when the operation of the initial system proved a success. This success having been shown, a further issue of city debentures to the amount of \$2,200,000, bearing the same interest, 4 per cent. and payable in forty years, was made for the extensions, and since then investments in other extensions have been made.

Although the trouble stirred up among the farmers between Toronto and Niagara had the effect of doubling the estimated cost of the right of way, yet in spite of this and of the fact that the towers were constructed more strongly and with double the number of insulators needed, the total cost of the transmission line was less by about \$150,000 than the \$3,500,000 estimated.

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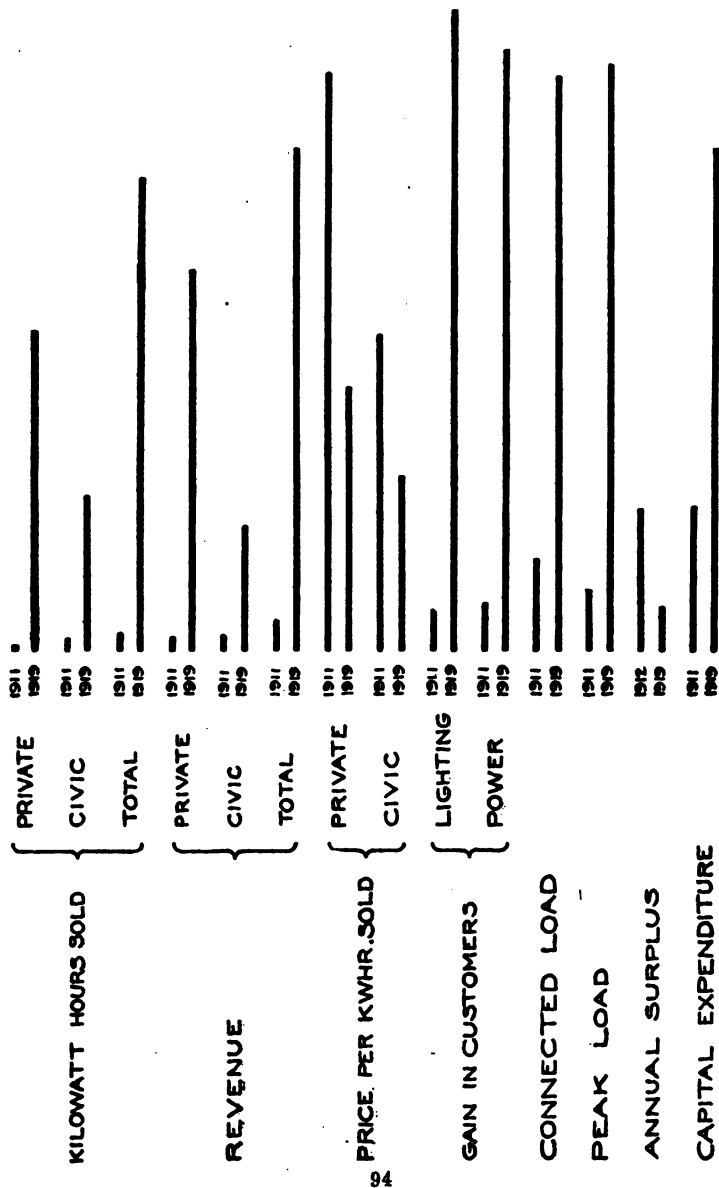
Within a year and a half from the beginning of field operations 300 miles of the Provincial Commission's main transmission lines were completed, and in February, 1911, power for the Toronto branch was first turned on in the city, a twenty-four-hour service being commenced in the following month.

Of the estimated total capacity of 60,000 h.p. provided by the Provincial Commission for the fourteen original participants, it was expected that 30,000 h.p. would be in demand at a very early date, and of this 30,000 h.p. Toronto became responsible for 10,000 h.p., which was to be purchased at \$18.10 per h.p. Toronto's share of the construction costs, transformer stations and works was \$828,000, and the city's assessment for line losses, maintenance and renewals \$38,970. The total of these and the city's own distribution works with the certainty of increased cost for extensions of the city system, all of which by 1913 made a grand total of \$5,120,000, were enough to start the circulation of gloomy predictions that Toronto was acquiring a white elephant of enormous proportions.

The actual outcome of Toronto's enterprise can be studied by the accompanying graphic statistics condensed from the report of the city commission, and brought down to the end of the calendar year 1919:

In 1912 the Toronto Electric Light Co. had 19,000 customers, and in 1914 these had increased to 22,000, since which date the company has ceased to publish its figures. At the end of 1911, comprising its first nine months, the municipal system had less than 4,000 customers, at the end of 1914 these had exceeded the private company, being 31,500. At the end of 1915 there were 38,834, and at the end of 1919 they were approximately 63,750. At the end of the first full year of 1912 there was a surplus of \$226,199 over operating expenses and maintenance and a net surplus of \$13,555 after meeting the sinking fund charges. Had the business been conducted

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Graphic illustrations showing progress of Toronto Hydro-Electric System compared with that of private company.

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as a joint stock company the surplus would have permitted a dividend of 5 per cent. this year; but the principle on which the Commission carries on its trust is that when the point is reached where surpluses are made beyond the provisions for the sinking fund the balance shall be restored by reducing the rates to the public. The surplus in 1913 was equivalent to a dividend of $7\frac{1}{2}$ per cent. on the cash invested, and the city gave a service in electric light and power cheaper than any city of similar size on the continent. In the first year and a half the amount of power used was approximately 6,000 h.p., in 1919 it was about 60,000 h.p.

Before the Hydro-Electric system came into the field the Toronto Electric Light Co. charged 8c per k.w.-hour for residences, 8c, 10c and 12c for commercial lighting, and $2\frac{3}{4}$ c to 6c for power. The rates of the Hydro System in 1914 were reduced to such a point that the average revenue obtained was 4c for residence, 2.85c for commercial lighting and 1.31c to power users. These average rates being equal to \$20 per h.p. per year. The rates in Montreal under private company operation in the same year ranged from \$30 to \$100 per h.p. per year to power users, and 6c to $7\frac{1}{2}$ c for residence lighting.

The surpluses in Toronto were such that reductions were made also in 1915 and again in 1916.

The following are the present rates in Toronto:

Residence Service.—There is a charge of 3c per 100 sq. ft. of floor area per month (the minimum area charged being 1,000 sq. ft. and the maximum 3,000); plus 2c per k.w.-hour up to the equivalent of 3 k.w.-hours per 100 sq. ft. of floor area charged; additional consumption 1c per k.w.-hour. A discount of 10 per cent. off the whole bill for prompt payment.

Commercial Lighting.—Five cents per k.w.-hour for the first thirty hours' use of the connected load or maximum demand; 3c. per k.w.-hour for the next seventy hours' use of the

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same; and 1c. per k.w.-hour for all above per month. Prompt payment discount of 10 per cent.

Alternating Current Power, 3 phase, 25 cycles, 550 volts.—Service charge of \$1.25 per h.p. per month for first 10 h.p. of connected load or maximum demand, balance at \$1 per h.p. per month as service charge on connected load or maximum demand; plus 1½c. per k.w.-hour for first 50 hours' monthly use of the maximum demand; ¾c. per k.w.-hour for next 50 hours monthly use of the maximum demand; balance at 0.4c. per k.w.-hour. Discount of 10 per cent. if paid in ten days.

Direct Current Power.—Service charge for first 10 h.p. of maximum demand or connected load per month \$1.35 per h.p.; service charge for balance \$1 per h.p.; first 50 hours' monthly use of the maximum demand or connected load at 2½c. per k.w.-hour; next 50 hours' use at ¾c. per k.w.-hour; balance at 0.6c. per k.w.-hour. Less 10 per cent. discount in ten days.

In considering the effect of the reductions mentioned it will be acknowledged that since the private company reduced its rates because of the advent of the municipal system the Commission is to be credited with the savings to the citizens from both sources. What these are in the case of the private company is not known in the absence of published details but the savings brought about by the municipal system alone in its eight years of service is calculated by the Commission at \$17,000,000—a sum greater in itself than the total capital invested in the enterprise, including the capital invested by the Provincial Commission on the right of way, tower lines, etc., connecting with the city. In the last eight years the coal saved in the city was over 2,000,000 tons, the supply of which during the fuel scarcity would have left the city in a bad predicament. The supply of munitions in Toronto during the war years would have been simply impossible without the aid of the Hydro-Electric System.

With reference to reductions, it is interesting to note that

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owing to the increased power taken by the Provincial Commission under its contracts, Toronto has shared two reductions in the cost of its light and power.

The Toronto Electric Light Co. appears to have been administered efficiently during the years of its competition with the municipal system. It had all the advantages of its previous experience, and it had the specific advantage of having wired and installed the connections with all the big buildings, many of which it still retains. It has had a fair field and an equal opportunity to obtain the new business due to the city's growth. Therefore, the claim that public ownership is uneconomical and private ownership superior in efficiency has met a straight challenge here, and judgment may be rendered upon the results.

We may speculate on what would have been the effect on the whole movement for public ownership of hydro-electric power in Ontario had the monopolist group in the first few years of this century, reduced its rates to a reasonable margin. The Toronto company had itself boasted that it could afford to reduce its rates 20 per cent. and still make a profit, but it sent no peace embassy to meet its opponent. It might have given as an act of grace the reductions it afterwards had to yield to the force of competition. It is possible that had this act of grace been manifested at the right time this group would to-day have remained the benevolent despot of power supply in this part of Ontario. The historic fact is that the company did not make such use of its opportunity, but left the municipalities to put into living practice the ideals which the private company might have striven for, if not attained to.

CHAPTER XII.

Organization of the Toronto System.

During the construction period the electrical distribution system of Toronto was administered as a department of the municipal services, but an Act passed in 1911 enabled the city to operate under a local commission. This Commission was to consist of three members, one to be the Mayor, as ex-officio member, one to be appointed by the City Council on the nomination of the City Board of Control, and the third to be appointed by the Provincial Hydro-Electric Power Commission. These members were to hold office for two years or until their successors were appointed, each member except the Mayor to have a salary of \$4,000 a year. The Commission's duties and powers were defined by the Municipal Light and Heat Act, but the Commissioners might ask for the issue of municipal debentures for the purpose of extending and improving the works. The title assumed was the Toronto Hydro-Electric System, and the first Commissioners were Mayor Geary, H. L. Drayton and P. W. Ellis. Mr. Drayton resigned to become Chairman of the Board of Railway Commissioners at Ottawa (and is now Minister of Finance), and R. G. Black, Electrical Engineer, succeeded him. Mr. Black resigned in 1918, and was succeeded by George Wright, a business man of wide experience and a resident of the city for fifteen years.

Mr. Ellis, who was elected first chairman and has remained head of the Commission ever since, had been one of the first members of the Provincial Commission, and was one of the champions of the cause before public opinion had become crystallized in favor of Government control and regulation of

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the water powers. Although, like Sir Adam Beck, he had large business interests, he gave most of his time and thought to the problem of devoting the resources of the Province to the needs of the people. He was convinced of the future value of Niagara power to the Province. In a letter to Sir Adam Beck during the early agitation he wrote: "The development of manufactures, light railways, etc., of the next few years will certainly increase to an enormous extent the demand for electric energy. It is therefore of great importance that this reserve power be retained in the hands of the Province as a public asset, to be developed only for the public good or if franchises be given to private companies to utilize, they should be given under such safeguards as shall effectually prevent the charging of excessive rates and the amalgamating of competing interests. The question should be considered by the Government, not from the standpoint of the demand of the next few years, or the necessity of a few decades but rather from the aspect of an endless evolution of the country's activity. If only a quarter of the 6,000,000 h.p. represented at the Falls should be diverted for commercial purposes it will have an almost unimaginable effect on the future development of Ontario." He illustrated the economic value by stating that the control of a million horse-power in the public interest at a valuation of \$5 a horse-power would afford a revenue greater than that derived from the total consolidated revenues of the Province for 1903.

The City Council has wisely refrained from interference in the matter of staff appointments, but left to the Commission the responsibility for the conduct of the business. The Toronto System is regarded as having attained a reputation for efficiency and economy.

The Commission does the pumping for the City Waterworks, lights the city streets with over 45,000 lamps, furnishes power for certain miscellaneous civic services, for most of the Dominion Government institutions and for the Toronto Exhibi-

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tion. For the convenience of its citizen customers it has become a dealer in lamps, heaters, irons and other appliances.

The administrative policy of the Toronto Commission conforms to that of the Provincial Commission. It does not operate to accumulate profits on the dividend plan but to fulfil these three conditions:

1st. To set aside from earnings a sum sufficient to meet the interest on the debentures used in the purchase.

2nd. To establish a sinking fund to provide for the extinction of the debentures when they mature.

3rd. To set aside a fund that will maintain the plant and replace it when worn out.

The policy of the Commissioners is to cheapen and diffuse the comforts of life among the citizens, and enable the industries of Toronto to reduce the cost of production; to maintain a higher class of service than before at relatively less cost, and to improve the social conditions of the employees; to show that municipal ownership can be successfully applied to great public utilities, and finally to prove that while lessening the cost of other municipal services, these important results can be accomplished without laying a dollar of taxation upon the ratepayers at large.

CHAPTER XIII.

The Electric Railway Era and its Significance to Canada.

The municipalities interested at the commencement of the power undertaking found difficulty in arranging meetings to carry on their work, due to poor railway facilities, but after they realized the wonderful success of their efforts in the power field it is not surprising that they commenced an agitation for a system of electric railways modelled along the same plan. Acting on their request Sir Adam Beck introduced the Hydro-Electric Railway Act in the Legislature in 1913, which Act authorized the Commission to prepare reports on electric railway lines when requested to do so by the municipalities, and also empowered the Commission and the municipalities to enter into agreements for the construction and operation of such lines after they had been endorsed by the ratepayers.

Just prior to the outbreak of the war, plans were well advanced for the construction of some of these lines which, it was felt, would supply a much-needed improvement in transportation throughout the Province, and would also assist the municipalities in securing cheap light and power. It was felt unwise to proceed with the construction during the war, but some engineering work, already in hand, was completed, and judging by the heavy majorities recorded within recent months in the voting on some of these lines, the ratepayers are firmly convinced that they will secure as great benefits from these publicly controlled railways as they have already obtained from publicly controlled power lines.

It is quite reasonable to suppose that Ontario is not entering upon a risky experiment but is basing its plans upon developments already well tried in American cities.

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The State of Indiana has only a population of some seventy-five people per square mile as against eighty in the case of south-western Ontario, and yet that State has sixty-five miles of interurban track per 100,000 people as against twenty-five miles for Ontario. Since the Indiana electrics mainly generate power by steam, and must provide a surplus for private profits, the Ontario lines as planned will have the cheaper operating costs of hydraulic power and no handicaps due to the need of private dividends.

The Commission and its engineers have gathered much data on the development of electric railways, and the electrification of steam lines now being undertaken in other countries, and it is upon this information that the Commission's plans are being carried out.

The new electric railway policy may be regarded as a means, first of giving communication to districts now poorly served, or not served at all, and, second, of providing links with the trunk lines which connect province with province. The local system is as necessary to the trunk lines as the trunk lines are to it, and no increased traffic facilities due to good highways can avail anything, generally speaking, unless this traffic is cared for by the electric and other railways. Present conditions, therefore, favor a beginning on a unified system of provincial electric lines.

The wonderful development of hydro-electric power is shown by statistics of central stations (including electric railways) in the United States. Energy from these stations increased from 11.84 h.p. years per 1,000 population in 1902 to 39.52 h.p. years in 1912, the increase being least in the eastern States, which have the most coal and the least water power, and greatest in the western mountainous States, which are so eminent in hydraulic power and deficient in coal. The increase in California, for instance, was 109.36, in Nevada 111.66, and in Montana 143.97. These statistics are of

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special significance to Ontario because of the figures for this province as given in a previous chapter and justify the electrical development plans of the Hydro-Electric Power Commission.

A few years ago it might have been urged that, even admitting the wealth of Ontario in hydraulic power, there were still insurmountable engineering difficulties to be solved in electrifying railways, but to-day all the engineering problems have been settled in favor of electric traction. A striking example of the superiority of electric traction is furnished by the Norfolk & Western Railway of West Virginia. This was a coal road and had all the advantages of cheap fuel, but on electrifying the Elkhorn Hill section its capacity was doubled over what it had been with steam. The Chicago, Milwaukee & St. Paul Railway now operate 440 miles of their system from Avery, Idaho, to Harlowtown, Mont., by electricity. In practice one of the new electric locomotives replaces four ordinary steam locomotives; it can run 1,000 miles without overhauling; and it has no ashes to dump or flues to clean. It is a well-known fact that the capacity of a steam locomotive is very much reduced in cold weather, due to increased radiation losses. The opposite is the case for electric locomotives, as the capacity of the motors is only limited by the heat they are able to dissipate and consequently they are able to perform heavier duty during cold weather. In addition to the foregoing advantage for the electric locomotive it also has a most interesting arrangement by which a portion of the energy consumed in climbing a grade is regained by regeneration on the down grade.

The principle by which this is accomplished may be described as follows: "When gravity pulls a train down hill it overcomes the inertia and friction, and as the motors are permanently connected to the driving wheels, it follows that they must revolve. By suitable connections these motors when driven in this way may be turned into generators delivering

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current to the trolley wire where it is used to assist other trains that are drawing power from the same wire. The steeper the incline, the stronger the pull of gravity, tending to increase the speed but the greater the speed the more electricity is generated by the motors. As the power delivered by the motors increases the stronger the pull back of the locomotive on the train, and thus the speed tends to be retarded. Again, by suitable connections this pull back of the motors may be controlled within a wide range and so any desired speed obtained." In the foregoing way the potential energy stored up in a train at the top of a grade is used in the case of an electric locomotive but wasted in braking in the case of a steam locomotive. Experience has shown that it is possible to make a saving of from 15 to 60 per cent. in the total power used on an electric division, depending upon the grade. As evidence of these advantages the Chicago, Milwaukee & St. Paul Company has increased its electrification from 220 miles over one section to a total of some 650 miles on three divisions.

The tremendous power that can be developed by an electric locomotive will be a further advantage to be secured by the electrification of main line railways in Canada, as this should practically eliminate the dangers and delays incident to snow blockades.

The electrification of Canadian railways should result in a saving of a vast amount of coal now burnt by the existing locomotives, and this applies even if electric power were to be produced from steam-driven generators for the following reasons: 1st, The steam locomotive is in reality a single unit steam plant and the advantages of high steam pressure and superheating cannot be attained in practice in so small a unit, as it can in large central stations. In the average locomotive it takes six pounds of coal to raise a horse-power of energy, but the same six pounds of coal in a modern central station plant will produce from two to four horse-power. 2nd, Gener-

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ating for a large number of trains from a central point economizes the total fuel consumption, and also eliminates the losses inseparable from so many units working under variable conditions—such, for example, as keeping up steam while trains are delayed.

Figures based on returns as published by the Interstate Commerce Commission of the United States show that if all the railways in the United States were electrically operated from steam-driven stations the coal consumption would be 39,500,000 tons annually, whereas the amount now actually consumed by locomotives alone amounts to some 120,000,000 tons. This saving of 80,000,000 tons annually is equivalent to one-sixth of the total coal produced in the United States.

With these very exceptional results from the United States before us how much stronger is the case for general electrification in Central Canada, where native coal does not exist, but water powers are abundant and well distributed? The price of steam coal in Ontario in 1920 has averaged \$10 or more per ton for industrial purposes. Taking the locomotive consumption at ten million tons a year for all Canada, complete electrification in the country would save an import bill of \$90,000,000 to \$100,000,000 a year after making allowance for the supplies of Nova Scotia and British Columbia. Yet, with the exception of electric haulage in the Mount Royal tunnel of the C.N.R. and the Sarnia tunnel of the G.T.R. the private railway companies of Canada for whom superior efficiency is claimed, have done nothing to put this national economy into effect in Ontario or the east.

For the reasons above cited it would appear that the problem of electrification is far more simple and the economy more certain in the Province of Ontario than in any other part of America, with the exception possibly of Quebec. The net advantage to the people is the same as if a dozen inexhaustible coal mines had been discovered in different parts of Ontario,

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whereby the province would be saved from the importation of many millions of tons of coal each year for transportation services, besides saving the waste involved in hauling such coal around the country to the points of consumption.

The Commission's railway policy now being evolved is based on the needs of the sections which are now without access to markets, but each new scheme will depend on the enterprise and confidence of the municipalities immediately concerned.

At present among the propositions taking shape are:

- (1) A line from Toronto eastward to Bowmanville.
- (2) A line from Toronto through Hamilton to the Niagara frontier . . . closing up two mysterious missing links left by private electric railways.
- (3) A line from Hamilton extending northward to the Galt, Guelph and Kitchener districts.

The first railway to be taken in hand by the Commission was the London and Port Stanley railway. This steam road, 24 miles in length, connecting London with its nearest summer resort on Lake Erie, had been unprofitable almost from its opening in 1853, was in a dilapidated state and was being operated at a loss by its owners, the Pere Marquette Railway Co. A crisis in the affairs of the road came in 1915-16, when the City of London appealed to the Commission to take over the line and operate it through a local commission. The Provincial Auditor objected to the use of the Commission's funds for this purpose, on the ground that the money had not been appropriated for this undertaking. When the private company interests took the occasion of the auditor's controversy over the purchase to insinuate that there was wrongdoing, the Commission accepted the challenge, and the Government appointed Mr. George T. Clarkson, an accountant of high standing in Ontario, to investigate the finances of the Hydro-Electric Power Commission from its be-



Eugenia Falls, power site of the Eugenia System.

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ginning to the date of the investigation—that is to the end of October, 1917. Mr. Clarkson, in a report of 147 pages, made suggestions by which the methods of accounting could be improved in form, but his report otherwise was a complete exoneration from the insinuations of the enemies of the Commission. The following is the concluding paragraph of the report, in which he acknowledges that every facility was offered him for his investigation: "I report that the accounts of the Commission are and have been well and sufficiently kept so as to distinguish between expenditures of a capital nature, chargeable to construction, and expenditures which are chargeable to the cost of operations, and that the vouchers supporting all expenditures made in the period under review have with few exceptions been adequate and properly certified to by the Chief Engineer or other responsible officers. My examination of the accounts indicates that certain alterations in their form can be made with benefit, some improvements which I recommended having already been effected."

Admitting that the technical requirements of the Provincial Auditor were over-ridden, the spirit of the Commission's aim to bring the advantage of cheap transportation to the various municipalities without loss to the province has been justified in the results of the London and Port Stanley transaction. In the very first year of the Commission's administration of the road, the number of trains per day was doubled, the speed of the cars greatly increased, the equipment improved and the roadbed made the best in the Dominion, yet with all the expenses involved in these changes there was a surplus of \$24,000 in the operations of the year, after meeting all charges, including taxes, sinking fund charges, etc. Moreover, it was realized that the great increase of traffic would justify the double tracking of the road; and in 1917 new steel cars, superior to anything yet introduced in Canada, were placed on the line. When taken in hand it was a ramshackle road, intensely unpopular;

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now it is a well managed, popular line, and in equipment a model radial electric railway. From 105,559 passengers carried in the last year of private ownership, the passenger traffic increased in 1919 to 958,587, and the revenue from \$14,000 to nearly a quarter of a million.

True to tradition, while under private management, the Grand Trunk Railway, which controlled the coal traffic of the Pere Marquette from across Lake Erie, threatened that if the public ownership plan were carried out the coal trade would be cut off. This threat was actually carried out, and coal shipments were diverted at a needless roundabout haul of 60 miles extra, until the Grand Trunk came under Government control in 1920.

The Commission has also taken over on behalf of the municipalities interested an existing electric line in the Windsor district, which connects Amherstburg, Sandwich, Ojibway, Windsor, Walkerville, Ford City and neighboring villages along the Detroit River. The equipment of the private company had run down, and the service was poor; these have both been improved, and there is already such an increase in revenue as to enable the Commission to make an advance in wages which had been refused by the previous management.

The degree of public interest in radial and interurban electric lines is indicated by the fact that up to the present about four hundred resolutions have been sent in to the Commission from municipalities in favor of such enterprises. The proposals already endorsed by municipal by-laws involve a total of approximately \$52,000,000 for construction. Over 2,500 miles of electric railway have been surveyed.

Some years ago a Municipal Hydro-Electric Railway Association was organized for Ontario, and this organization has about three hundred municipalities represented in its membership. The work of the Association is now being strengthened by the formation of an "Eastern Ontario Hydro-

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Electric Association," which is demanding that the unutilized water powers of the St. Lawrence be harnessed in the transportation and power interests of that section of the province, which has so far received little of the benefits of hydro-electric power.

During the summer of 1920 a Commission was appointed by the Provincial Government to report upon the feasibility of the electric railway projects planned by the Hydro-Electric Power Commission, and the investigations of this Commission are now being held. The new administration of Ontario, known as the Farmers' Government, upon taking office in 1919, were urged to embark on a system of highways which would excell that of any other province, and this was conceived to be in the special interests of the farmers as a class. Said a member of the Government: "We are going to put into effect a good roads system which will be a vital factor in the life of the urban and industrial population, as well as those devoted to agriculture. This will bring into effect a new system of transportation designed to meet the needs of the people, as no other would." As no direct revenue is now obtainable from roads, the question arises, what funds may be diverted from other public works if the plans of the new Minister of Highways are to be satisfied.

Caution is commendable in a new government, but there need be no fear of a fair examination of the merits of electric traction in relation to farming communities. A little reflection will show the farmers that even in their own class interests, highways, however good, are not the beginning and end of a modern transportation system. If every side-line and concession in the province were converted into a highway adapted to the heaviest motor traffic, the system would perish of strangulation without its other component parts.

The modern transportation system may be likened to the circulatory system of the human body. First there are the

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main arteries and veins conveying the life blood from and back to the heart. Then there are the branch arteries and veins by which the main current of blood is distributed to the little "arterials" and veinlets which bring vitality to the muscles, nerves and bones of the remotest parts of the body. The main arteries and veins are the trunk line railways (whether operated by steam or electricity), the secondary arteries and veins are the local electric lines and the "arterials" and veinlets are the roads by which the electric railways connect with the farms, market gardens, lumber camps, mines, quarries, etc. The above analogy is complete; and the notion that any one of these three departments can develop without the other, or be made a complete transport system in itself, betrays a misconception of the requirements of the modern community.

In a recent year over fifty steam railways in the United States passed into the hands of a receiver, but does anyone imagine that because of these failures the people of the U.S. will attempt to do their public business without railways? Will the people of Canada tear up all the tracks of the Grand Trunk and Canadian National because these systems show a deficit on the present years' operation? One cause, however, of the stagnation of some Canadian steam lines under private ownership is their failure to see that electric lines would help them by collecting package freight and interurban traffic, with a speed, flexibility, cheapness and frequency which no steam road could accomplish. On the other hand, the motor truck for farm haulage, while it is efficient for limited distances, cannot compete with the electric line in transport from town to town and is hopelessly outclassed where passenger service is concerned on extended routes.

The gross earnings of the electric railways of the U.S. have increased in the last ten years from \$435,461,000 to \$783,514,000, and in spite of the higher costs of labor and materials in the war years, the net margin over operating expenses of these

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lines increased from \$168,770,000 in 1918 to \$185,077,000 in 1919. No such progress has been shown by the steam roads as a class. Indeed the one fact that the steam roads of both the United States and Canada are now pleading *in forma pauperis* before their respective governments for a revolutionary increase in rates to save them from financial collapse is ample proof that the electric systems, within their sphere, are beating them in economy and efficiency.

A very few figures will suffice to show the solid ground on which electric traction has advanced in Canada. The Canada Year Book for 1918 shows that from 1901 to 1917 the passengers carried on the sixty-five electric systems of this country multiplied over five times, as against an increase of less than three times in the case of steam roads, and that the tons of freight carried increased more than eight times in the case of the electrics as against less than four times on the steam roads in the same period. The net earnings of all the electrics in 1918, as reported in the "Railway Statistics," were \$6,805,574, and after paying all taxes and interest on their funded debts their net income was \$3,645,624. The ratio of expenses to receipts of the electric roads that year was 66.47. Set these facts beside the pitiful plea made before the railway commission this year that for every dollar received by the steam roads more than a dollar is paid out in operating expenses. The ratio of growth in electric mileage has been over 50 per cent. greater than that of the steam roads in the period named. If the town-to-town electric systems of the U.S. and Canada have made this headway against the handicap of uncalled for "promotion" expenses and the watering of stock under private ownership—not to speak of the misconceived opposition of many of the steam roads—how much more in the public interest is the plan of the Hydro-Electric Commission for the creation of a system that will give alike to rural and urban communities the advantage of the cheapest possible transit service without

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the dead-hand of the promoter's profit, or of the private franchise which so soon becomes a heavy mortgage on the people's birth-right.

In observing what has been achieved by interurban electric railways in such States as Indiana, Illinois, Michigan, New York, and the New England States in developing inter-town traffic and in providing new markets for farmers and gardeners, the Hydro-Electric Power Commission has been very conservative in its modest plans for electric lines in south and south-west Ontario, and it is to be commended for providing its own right-of-way into cities like Toronto, thus avoiding the great loss of time which handicaps electric lines in American and British cities in passing through city streets. The Commission and its engineers have probably given more study to the electric railway problem than to that of light and power, and their reputation would be more jeopardized by miscalculations. This places upon a government the greater responsibility for any act of its own which would tend to paralyze the progress of the province.

To sum up the situation, a good roads system is incomplete without an electric system as its counterpart, and the incontrovertible proof of this is that there is no known instance where the establishment of an electric railway has not tended to raise the value of farm lands along and near the route. This is the judgment, based on experience, of the farmers and gardeners whose interests are most affected.

It is now not a question of duplicating steam railways but of rendering for Ontario, as in the American States mentioned, a kind of public service which the steam roads never have supplied and from their nature never can supply.

The policy of the Commission, which has wrought such a wonderful transportation in the industrial life of Ontario, and in the attitude of the people towards public affairs, as affected by power, will be still more completely justified when hydro-

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electric power is applied to railways, and it is inconceivable that the principle of public ownership, after the triumphs of the last fifteen years, will now be abandoned and the people cravenly submit again to the supertax of private profit in a function which most vitally touches their daily life and well-being.

But while on the point of efficiency there is another example from Ontario which is useful for comparison. The Provincial Government about twenty years ago made a survey of the great "clay belt" of North Ontario—a plateau of 20,000,000 acres, into which Vermont, New Hampshire, Massachusetts and Rhode Island might be placed, leaving three thousand square miles still uncovered—and this survey was followed up by building into this unsettled domain the Temiskaming and Northern Ontario Railway as a Government work. The Cobalt silver mined as the result of this State enterprise has amounted to \$195,000,000, or ten times the cost of construction of the 330 miles of line, not to mention the many industries and farming areas opened up. Why did not the private railway corporations, two of which already had lines touching the southern borders of this region, take up the invitation to build this road, for which a Government subsidy was waiting them? The reason was that they were too busy lobbying in the Provincial and Federal Parliaments for public funds to enable them to build lines to centres of traffic already created, and to give the public the form of "competition" without its reality in the reduction of transportation costs. The Ontario Government's railway exemplifies the difference between the statesman's conception of State service and that of a company exercising a public function for immediate profits.

Once more public ownership stands ready to fulfil a State duty which private ownership has failed to see. At the present moment there is discontent in Northern Ontario because colonization and industrial and mining developments

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have gone beyond the means of transport. Such a situation can be met by a new method. Heretofore wagon roads have preceded railways; but in view of the potential power of these northern regions an ultimate saving of money and labor can be realized by the construction of narrow gauge or standard gauge electric lines at the start, leaving radiating wagon roads to be built as feeders. The extension of the Ontario Government Railway from Cochrane, its present terminus, to tide-water on James Bay or Hudson Bay should be prosecuted as an electric road from the start, for it is alleged by a deputation recently before the new Premier from North Ontario that a million horse-power is there waiting to be harnessed in such a service in this new imperial domain.

CHAPTER XIV.

The Electric Railway Act.

By an Act passed in 1913 the ground was formally prepared for the plan originally contemplated in the administration of the large water powers—the extension of the service to electric railways. This Act is known as the “Hydro-Electric Railway Act,” and authorizes any municipal corporation to contract with the Hydro-Electric Power Commission for the construction and operation of an electric railway on practically the same plan as for power service. The following are the main provisions of the Act:

Upon request from the Lieutenant-Governor in Council the Commission may report on the cost of building and operating an electric railway in any locality in which the Commission supplies power, the report to show the number of municipalities to be served, their population, the probable revenue from the railway, and its economic value to the area. Upon receiving authority from the Lieutenant-Governor in Council any one or more of the municipalities interested may enter into an agreement with the Commission. Such agreement may provide for (a) the location of the line, (b) the kind of equipment and service to be furnished and the transportation rates to be charged, (c) the proportions of cost, maintenance and operation to be borne by each corporation, (d) the issuing of debentures for raising the amounts of each contributing municipality, (e) the proportion of revenue payable to each municipality after deducting expenses, and (f) the construction of the railway on any transmission line right of way acquired by the Commission.

For the payment of the annual instalments due the Com-

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mission for costs of construction, maintenance and operation, the passing of a by-law is not necessary.

Where the railway is carried on by the municipality it shall be done by a Public Utilities Commission, to be approved of by the Lieutenant-Governor in Council, and operating as a utilities commission appointed under the "Public Utilities Act."

The powers of the Commission for construction and operation and for the requisition of land are the same as exercised under the Ontario Railway Act and the Public Works Act.

After payment of working expenses and interest charges the Commission shall pay over the credit balances, if any, to the contributing municipalities according to the share due to each.

No action shall be brought against the Commission or any of its officers under the Ontario Railway Act without the consent of the Attorney-General of the Province; nor shall the Province or the Commission be held liable by reason of any error or omission in estimates, plans or specifications furnished by the Commission.

The railways, properties and effects held under this Act are held in trust for the municipalities who are parties to the agreements.

An amending Act was passed in 1914 which required that in submitting a by-law for an electric railway the by-law shall state the total cost of the proposed work, the proportion which the municipality submitting the by-law shall pay, also the proportion of charges required for maintenance, interest and sinking fund, and the agreement itself with the Commission shall be set out. An agreement for a railway comes into effect only after approval of the ratepayers through a by-law, and after sanction of the Lieutenant-Governor in Council.

This Act enables any group of municipalities to build their own roads if they think it in their own interest to do so, the

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amount of the Commission's bonds in such case being a first charge upon the property. In this case neither the Province nor the Commission is held liable for payment except to the extent of the moneys received by the Commission as net revenue from operation, or as moneys received from the sale of debentures. Notwithstanding this the Provincial Treasurer may be authorized to guarantee the payment of bonds issued by the Commission the terms of the guaranty to be determined by the Lieutenant-Governor in Council. There may be construction by the Commission and operation by the municipality, or both construction and operation by the municipality, but in either case the power is to be furnished by the Commission.

Deficits in operation are to be made up by the municipalities concerned; and deficits in amounts required for construction shall be made up by further debentures to be held as collateral by the Commission.

In 1915 the Hydro Electric Railway Act was so amended as to enable a section of a rural municipality to take part in a railway enterprise without involving the whole township. The proceedings correspond to those mentioned in the paragraph referring to participation in power and lighting service.

In 1916 the Hydro Electric Railway Act was further amended by requiring that a by-law for a railway must first be submitted to the Lieutenant-Governor in Council and a period of three months must elapse before the voting on the by-law. Railways already existing may be purchased, but a municipality, having purchased a road, may not sell it without a by-law. The authority of the Commission to make regulations for the safety of the public is extended over privately owned electric railways, officers of the Commission having the right to inspect such roads and order alterations. Penalties are provided for non-compliance.

The Hydro-Electric Railway Act was amended at the session of 1920 so as to limit the liability of the Province to the amount

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of the bonds issued for a railway purchased or built and giving the bond-holders such rights as shall constitute a first mortgage on the road. A new railway planned under the Commission may be constructed and operated by sections where the Commission so decide. Construction of a line may not begin till the Lieutenant-Governor in Council has authorized it. The estimates, agreements and by-laws relating to such work have also to be approved by the Lieutenant-Governor in Council.

CHAPTER XV.

Niagara Power on the New York Side

It was natural that there should be an earlier and more extensive use of Niagara power on the American side. Capital was keener for investment there; Buffalo, already prominent as a transportation centre, was near at hand, and the Hydraulic Power Company had the facilities of its canal and wheel pit, for a first demonstration.

If very few of those who saw the first electric lights in the town of Niagara Falls in 1879 could have foreseen the developments of to-day, fewer still ever anticipated that chemical and metal products, till then scarcely known outside of the laboratory, would owe their advent in the commerce and industry of the world to Niagara power and the electric furnace. Hydro-electric power was delivered here in 1895 and its first application in electro-metallurgy was in the making of aluminum. In the City of Niagara Falls, N.Y., there are to-day seventy-three industrial establishments, nine-tenths of which would not have been established but for the advantages of electric power from the Falls, and over thirty of these were directly begotten of electric power. Of the latter class it may be said that they make an aggregate greater in money value than the chemical products of all the rest of the continent, and relatively of still greater value as indispensable to applied science. A few years ago Niagara Falls and vicinity was producing about two-thirds of the electro-chemical products of America, and so important to the nation were these products that when the United States entered the European conflict the War Department found it necessary to assume control of the whole power output to the amount of about 278,000 h.p. and to place special guards over

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the plants to make sure of the manufacture of chemicals for war purposes. The allotment for war chemical production was increased by about 24,000 h.p., with the friendly co-operation of the Ontario Hydro-Electric Power Commission.

Of the numerous products that could not have been made in large quantity but for the high temperatures and perfect control obtainable from the electric furnace the following may be specified: aluminum—which when first made was sold at \$90 a pound, and is now so cheap as to be familiar in every house in America; artificial graphite, now more uniform in quality than that from the mines; carborundum, aloxite and other artificial abrasives; calcium carbide; electrolytic alkalis, bleaching materials, carbons and electrodes and many metallic alloys. A booklet prepared by a member of the American Chemical Society for the Niagara Falls Chamber of Commerce specifies over 200 chemical and metallurgical products based on the power of Niagara.

Niagara Falls once lived on the tourists in summer and hybernated in the winter, like the bear, on the fat produced in the summer. Now it lives on hydraulic power, and winter and summer are alike in industrial life. When the City of Niagara Falls was incorporated in 1892 it had a population of about 10,000; now its population is over 60,000.

The City of Buffalo has grown from about 255,000 at the census of 1890 to about 530,000 at the present time; and had Niagara power been available there as cheaply as at Niagara Falls city, its industrial growth might have been nearly as great in proportion. Buffalo has not been able to obtain as much power from the Falls as the city has desired, and, as already stated, a large part of this comes from the Canadian side. But in recent years the various public services have been gradually brought under one large private corporation, the Buffalo General Electric Co., which owns the power, lighting, street car and other public utilities, and controls the transmission of current

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from the Falls. The distance from the Falls to Buffalo on the New York side is from 18 to 27 miles, according to route, and the point of distribution of current; the distance from the Falls to Toronto is 80 to 90 miles according to route. The systems of measuring for light and power differ in the two cities, but for like services in domestic lighting the rates in Toronto are less than half those of Buffalo, and rates for power are substantially less in Toronto. The street lighting costs the City of Buffalo from \$25 to \$75 per year per lamp according to the type of lamp; in Toronto under the Commission the rate in 1918 was \$7 per lamp per year, a reduction of \$1 per lamp from the rate of 1917. The fact that even now the Buffalo General Electric Co. raises by steam 80,000 h.p. out of a total of about 120,000 h.p. used by that city furnishes internal evidence of the wide gap between the true cost of Niagara power—allowing a fair return on the capital actually required to produce power—and the prices that the citizens have to pay. In the steam plant of this company, which is one of the most efficient in the United States, it requires six tons of coal to produce one electrical horse power per year. Dr. Geo. Otis Smith, Director of the U.S. Geological Survey, in reports on coal conservation estimates that up-to-date steam plants require one and one-half to three pounds of coal per kilowatt hour, depending on the grade of coal and other factors. This accords closely with the estimate above given on the horsepower basis. At the present price of coal it must be plain that the citizens of Buffalo cannot, under this policy, get the full benefit of Niagara Falls power. It is doubtful if any relief is expected, seeing that the company has already spent nearly \$6,000,000 on its steam plant and is now installing further units of about 46,000 h.p. to be generated by steam.

Seeing that so much of its power is raised by steam it must be assumed that whatever profits it makes on its various other public utilities, the power service by itself is furnished at reasonable rates; but the fact remains that the citizens of

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Buffalo, so near the Falls, are paying for steam generated power while Toronto and Hamilton are getting hydro-electric power at less than half the cost.

The explanation of the great industrial development of Niagara Falls, N.Y., is that in the early years of electric power production the power companies were themselves searching for new uses for their output, and were glad to sell hydro-electric energy in large "blocks" at such low prices (\$14 to \$18 per h.p. per year, while one contract was made for about \$9) and on such long terms of service that the projectors of the electro-chemical and electro-metallurgical works would feel safe to invest money in these enterprises. Cheap power was, in fact, the creator of those key industries, which in turn led to the establishment of other industries using the new chemicals and metals for by-products, further diversifying the manufactures of the city and surrounding villages. Cheap power is still Niagara's breath of life. To radically raise the price of power when it was only the cheapness and great volume of power that made these products possible would disrupt the whole chain of the city's industrial life.

The situation now is that the two leading power companies (the Hydraulic Power Co. and the Niagara Falls Power Co.) have been merged into one huge corporation under the name of the Niagara Falls Power Co. with a capital of \$26,000,000 and a bond issue of \$28,000,000, controlling practically the entire output of power on the New York side, and having plans now advanced for such changes in their power plant as will enable them to obtain 100,000 h.p. more without increasing the amount of water diversion allowed under the treaty. The corporation, however, did not inject new water into its capital on the occasion of this merger.

One would suppose that the citizens of Niagara Falls would be specially favored in obtaining light and power for civic services, but this does not appear to be the case. A comparison of

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the lighting bills of houses using the same amount of current for lighting and domestic work, such as ironing and heating, shows that Toronto charges are about one-third those of Niagara Falls, though the latter has the source of power within its own city boundaries. The only civic service carried on by the municipality of Niagara Falls is that of the waterworks, and even the pumping for this is in the hands of a private company which does the pumping at \$16 per h.p. per year. The city pays \$45 per year per lamp for arc lighting.

If both Buffalo and Niagara Falls are under the reign of private ownership, and Niagara Falls has now six times the population it had in 1892 while Buffalo has only doubled, is there not something to the credit of private ownership in the case of Niagara Falls? To answer this question we have to recall the conditions which gave Niagara Falls this increase. The power companies had spent huge sums on the hydraulic developments at a time when the cost of transmitting to long distances was not so well determined as since; they had also bought large tracts of land around the city and were therefore faced by a crisis which could only be resolved by turning large blocks of power and land into large blocks of revenue. The companies were naturally interested in the growth of the city, but increase in population was incidental to, and not the primary purpose of, the sale of the hydro-electric power which created the new chemical and other industries. The fact was that the city power and lighting business was in the hands of a private company now known as the Niagara Falls Electric Service Corporation which was already controlled by the Buffalo General Electric Co. For some reason not apparent the rates charged to the citizens of that city, within whose borders the power is produced, are higher than in Buffalo itself. To see the population increase six fold and yet to be able to keep up the rates for domestic current and for power for the city would be regarded as good business by the company and its distributing agency

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from the public tax collecting standpoint. But had the production of the power, and the distribution of it, been in the hands of the municipality from the beginning, surely the enlightened self-interest of the citizens would have impelled them to offer the same low rates to create the electro-chemical industries, while such low rates as rule in Toronto for domestic and civic lighting and power would have been a yet greater magnet in attracting population.

The situation on the New York side seems to be explained by the following extracts from an investigation of a joint committee of the N.Y. legislature published in 1918. "We find a generating company, a transmitting company and a distributing company with directorates interlocked and the stock of the one owned by the stockholders of the other. . . . The main consideration for the majority of the stock in the Cataract Power and Conduit Co. which the Niagara Falls Power Co. owns, was the transfer to the Cataract Power and Conduit Co. by the Niagara Falls Power Co. of a franchise to operate in Buffalo, which franchise cost it nothing. The Buffalo General Electric Co. received its power from the Cataract Power and Conduit Co., having very largely the same officials and directors. The relations existing between these three companies seem to be so close that one company can charge whatever it pleases and receive any price it wishes, as is borne out by the fact that the Niagara Falls Power Co. charge the Cataract Power and Conduit Co. twice what it does other consumers, and the Cataract Power and Conduit doubles its charges to the Buffalo General Electric Co. over what it charges the International Railway Co. . . . While the Niagara Falls Power Co. has paid dividends at the rate of 8 per cent. and still had left a surplus about equal to 8 per cent. more; and the Cataract Power and Conduit Co. has had its separate surplus, and the Buffalo General Electric Co. has had its separate surplus, your committee is led to the irresistible conclusion that the ultimate consumer of electricity is paying into

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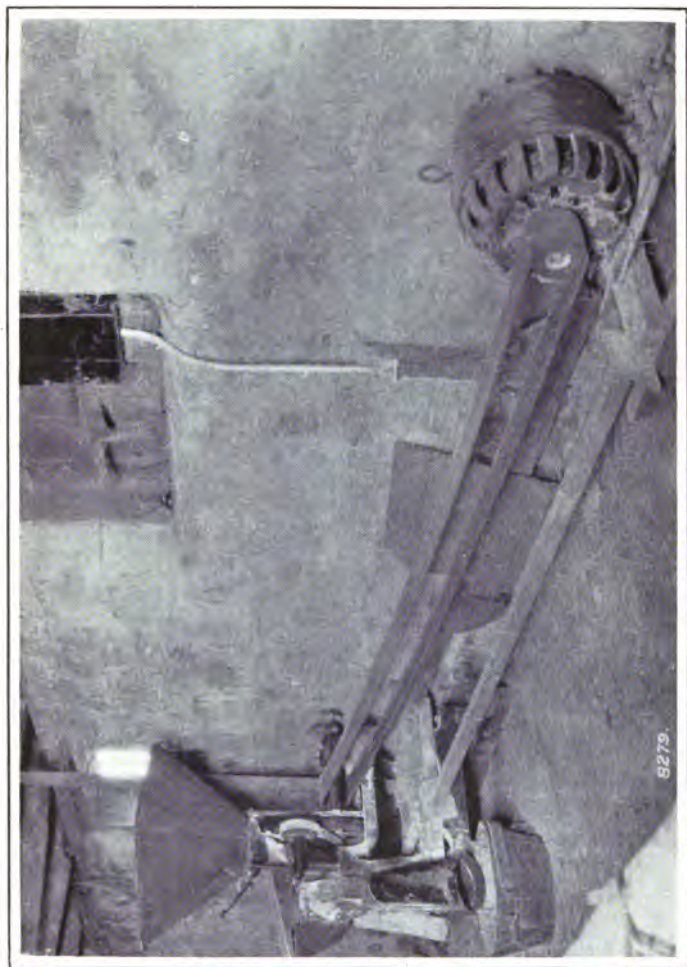
the three pockets of the one coat of the private hydro-electric corporation . . . giving an exorbitant earning to the three companies."

As the names of the directors, officers and shareholders are given in proof of the combination of interests, here is good collateral evidence that as far as concerns the citizens at large the communities within electrical range of Niagara Falls in the State of New York are to-day fettered in an economic servitude from which the Hydro-Electric Power Commission have set the people of south-west Ontario free—a liberation which they aim to bring to every other part of the Province.

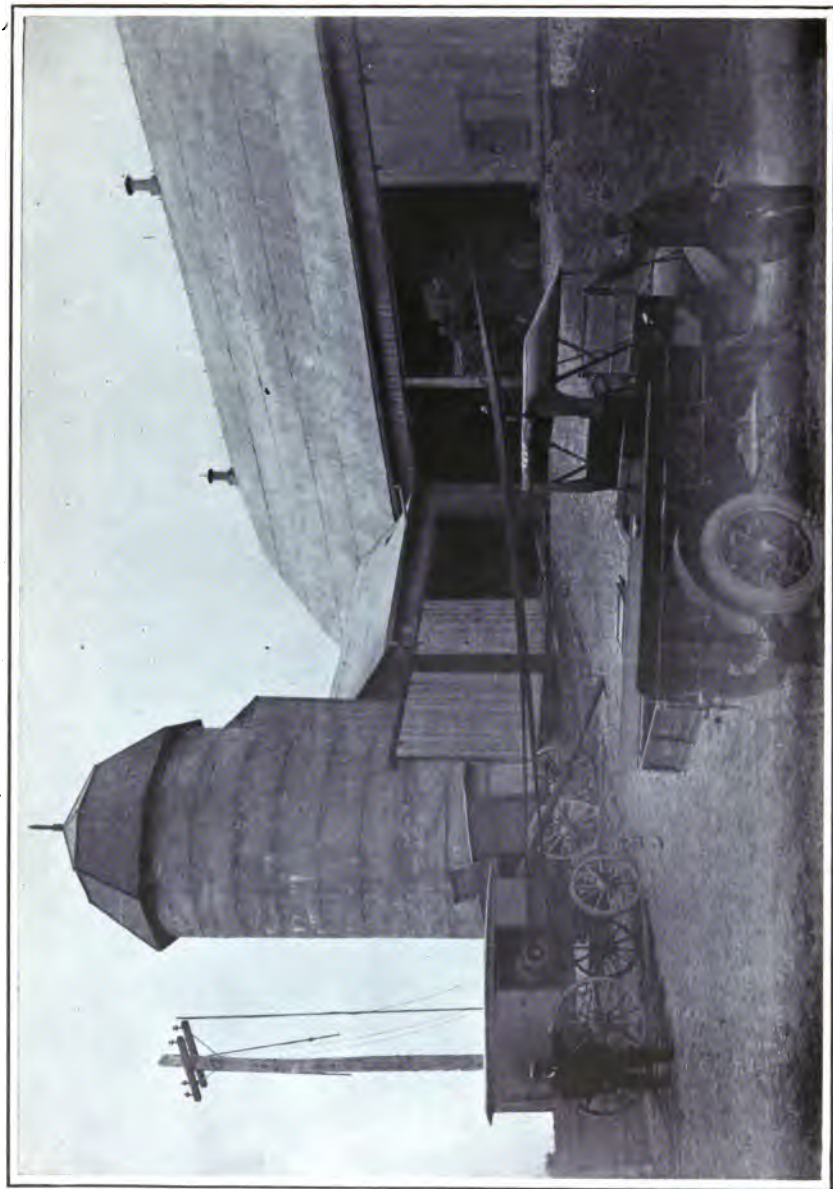
Without analyzing the motive of the Niagara Falls Power Co., that which they did was in the public interest in this respect, that by fixing a price which in United States experience was unprecedentedly low for large blocks of power, they provided the pioneers of the electro-chemical and electro-metallurgical industries with an insurance against failure, and against such increases in the cost of the energy as would annul the benefits to the community. Whatever one's belief or disbelief in public ownership, it is evident that every increase in the cost of primary power restricts its service to the community, and the result is the same whether this increase is designed as a levy or tribute upon the first users of the power, or upon the public who are ultimately affected. There was at the beginning at Niagara Falls, N.Y., no "stepping up" of profits on the production of power; the creation and maintenance of the new industries became the first considerations. Out of the cloudy oblivion of unnumbered ages there was awaiting the service of humanity on the Ontario side the same opportunity but upon like conditions; that the special industries now to be created should regard, as the primary law of their being, the service they could render to the people without regard to the profit in operation. The history of power sales on the Ontario side has been that while the Hydro-Electric Power Commission sought to afford power dis-

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tribution at as near cost as possible, giving the benefits to the entire community, the plans of the private power companies provided for a series of five stages at each of which it was intended to take a profit from the consumer. With one exception, the rates demanded by the private power corporations on the Ontario side show that these toll-gates were erected and designed to take the tolls, and as a matter of record no toll-bar has been voluntarily withdrawn out of consideration to the public. Rather than sell large blocks of power at as near cost as possible it has been the policy of the Ontario producers to sell power at as high a profit as obtainable, and hence under this policy industries of great public importance remained unborn because the subsidiary industries that grouped around the electro-chemical works of Niagara Falls, N.Y., being unable to get more power from the New York side, were compelled to pay the tribute levied by the Canadian companies and imported the power. The industries were lost to Ontario because the private Canadian companies took all the traffic would bear. Had the principles which guided the Hydro-Electric Power Commission been apprehended by the Ontario governments of these early days, all the achievements on the New York side in creating electro-chemical industries would have been excelled on the Ontario side. The Electrical Development Co. neither opened the door for these industries nor gave the benefit of the low rates to the people at large. The plan actually submitted to the Provincial Government of carrying a canal through the Park would, by increasing the head, have given an extra million horsepower at less cost than by these private companies. This is shown by the facts mentioned in the appendix. It must be admitted that the Ontario Governments of those days were less concerned about the benefits of a public power policy than they were about shifting the burden of maintaining the National Park. They sacrificed the greater for the narrower aim, and the public resources were made subservient to private profit.



A Feed Cutter Operated by Hydro Power.



Electric Motor Operating a Thresher.

CHAPTER XVI.

Electricity on the Farm.

The policy of the Hydro-Electric Power Commission in dealing with rural municipalities is designed to encourage the greater use of electricity on the farm.

Some years ago Sir Adam Beck took a staff engineer to Europe to investigate all that had been done there in applying electric power to farm operations, and adapting this information to conditions in Canada experiments have been made in various counties of Ontario. A start was made as early as 1910, and each year demonstration outfits have been taken from place to place to educate farmers in the use of electric power.

There has been a steady progress in most parts of the province in the use of this power on farms for lighting and domestic work, such as washing dishes and clothes, churning, pumping water, sweeping floors, ironing, baking bread, operating sewing machines, etc. In out-of-house work electricity has been used for filling silos, milking cows, threshing grain, grinding grain, chopping straw and feed, pumping water for the stables, grinding tools, sawing wood and loading and unloading wagons. In this class of work the progress has been sporadic rather than general, according to the density of settlement and the co-operative spirit of the farmers. There are townships where practically no advantage has been taken of the new power, while in others electricity has entered as extensively into the labor of farmhouse and farms as in the towns. For instance, from the town of Tillsonburg, thirty-three miles of line were run in 1917 to thirty-one farms; from the hamlet of Brownsville to fifty-eight farms, and to smaller groups of

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farmers in many other townships. From the village of Norwich, in Oxford County, there are thirty miles of hydro lines radiating in various directions to over 130 farms. Here and in other places a common practice is for a group of farmers numbering half a dozen to a dozen to use a twenty horse-power transformer and a motor of two to five or more horse-power. When heavy work is wanted by one farmer, such as filling a silo or threshing, the others limit their demands to lighting and small domestic use, and await their turn for heavy duty with the motor. In this way, by a little neighborly accommodation, all are served at a cost lower than by other sources of power for the same amount of work. At first, in the farms around Norwich a flat rate of \$96 a year was charged for a two horse-power motor, but this plan is being discarded for measurement by meter. Records are being kept of the operations and costs by various groups of farmers, so that in time the most economical practice will be worked out. One syndicate of six farmers used in a year 2,378 h.p. hours at a cost of \$106 for out-of-door work, and for their lighting and house work 1,117 h.p. hours at \$280. Another syndicate of seven used in the year for all services 8,265 h.p. hours at a cost of \$297.54. From the fact that gasoline engines have been replaced in these districts, and that up to the present no other form of farm power has replaced the electric, it seems certain that hydro-electric power is the best, and that by the saving of labor in the present time of higher farm wages electricity will bring about important changes in agriculture in Ontario.

In what may be classed as agricultural industries, such as the operation of milk condensing factories, milk powder factories, cheese factories, creameries, brick and tile making plants and gravel and road-making plants, electric power has become generally applicable in rural Ontario.

The Commission itself has become a farmer, having decided to put into cultivation lands on the right of way of the

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new Chippewa-Queenston power canal, in the Niagara district. A start was made in the autumn of 1917 on 607 acres, and in 1918 1,195 acres were put under cultivation. The first efforts have been devoted to restoring an exhausted soil, but in 1918 over 9,000 bushels of grain were raised and considerable quantities of fruits and vegetables. The Commission, however, does not expect to make a direct profit in farming but rather to reduce the cost on the high-priced land of the district. Sir Adam Beck has made the interesting suggestion that out of such large developments as that proposed on the St. Lawrence the Province should allow the Commission to set aside a small rental, say fifty cents per horse-power as a grant to encourage electricity on the farm.

It has been found that in many cases service was rendered to a favored few to the exclusion of other farmers. In order that a maximum area might be served from a distribution centre investigation surveys have been made and the area divided into districts over which a uniform rate will apply.

In order to obtain a more equitable distribution of the cost a new classification for users of Hydro-Electric service in rural districts has recently been made as follows:

Class 1.—Hamlet Lighting—Includes all contracts where four or more consumers are fed off one transformer for house lighting only.

Class 2.—House Lighting—Includes all contracts where residences are served that cannot be grouped as hamlets. Farmers and power customers may not receive service under these two classes.

Class 3.—Farm Lighting—Includes the lighting and the operation of miscellaneous small equipment of a residence and out-buildings on a farm.

Class 4.—Lighting and Cooking—Includes the lighting and the operation of miscellaneous small equipment of a residence and out-buildings on a farm and service to an electric range.

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Class 5.—Light Farm Service—Includes the lighting and the operation of miscellaneous small equipment of a residence and out-buildings on a farm and service to a five-horse-power motor, but not an electric range or electric heaters.

Class 6.—Medium Farm Service—Includes the lighting and the operation of miscellaneous small equipment of a residence and out-buildings on a farm and service to a five-horse-power motor and an electric range, or to a ten-horse-power motor without the electric range or electric heaters.

Class 7.—Heavy Farm Service.—Includes the lighting and the operation of miscellaneous small equipment of a residence and out-buildings on a farm and service to a ten or twenty-horse-power motor and an electric range.

Class 8.—Syndicate Outfits—Will include any of the foregoing classes which may join in the use of a syndicate outfit as long as the summation of their relative class demands is equal to the kilowatt capacity of the syndicate motor. The general use of electric power on the farm would seem to depend largely on two factors, (1) the nearness of the farms to a main power line, and (2) the number of farms that can be economically reached from one transformer. Except in very densely settled fruit and market gardening districts it would seem that for some time to come a given amount of power can render a more important service to large areas of land, and to the communities who are yet to live on them, by first building electric railways through districts not possessing good communications, and then distributing power to the farmers from the main transmission lines. Where electric lines are already built the cost of power to farmers is reduced by \$5 to \$15 per horse-power per year. In many situations, such as in hilly districts, narrow gauge lines can be provided, as they were improvised during the war in Flanders, at one-quarter to one-eighth the cost of our standard gauge lines.

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The record of the Commission in electrical service on the farms of Ontario is of value to the student of economics, for it tells us why the theory of administration for profit never has and never can measure up to the just expectations of the public. There have been a number of private companies whose field of operations has been in those parts of the province where settlement is densest and education and wealth greatest—that is in the Niagara district. One of these companies generates at an operating cost lower than any plant working under the Commission, and the other has repeatedly boasted of its efficiency and its ability to compete with all comers. Why have these companies done practically nothing for the farmers of the finest fruit growing area in Canada in introducing power for farm operations? Simply because there is more direct and immediate profit in selling power to the cities, towns and individual factories who take larger “blocks” of power for a given amount of outlay and operating costs. Hence they have distinctly discouraged the diversion of their power to farm purposes. It is only right and natural that a company created for profits to its shareholders should take this view of business, because dividends to shareholders depend on it. But private ownership of public utilities boasts of its superior efficiency. To what end is this efficiency directed? Manifestly to pay dividends to the shareholders and to increase the value of the stock. Now the policy of the Commission has been to give the widest distribution of power, consistent with cost of the whole, and this view takes in the farming community, upon which after all is built the superstructure of the wealth and prosperity of the State. It would not have been possible to introduce electricity in a single township in Ontario—as it has not been done in a single parish in Quebec to any extent where private ownership prevails—on the basis of direct profit in power operation. There is little doubt that if the people of Ontario had left the great water powers as the prerogative of monopoly-hunting

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companies a considerable local industry would have been built up at Niagara Falls and two or three other spots, while the depopulation of rural Ontario at large, which is giving so much concern to our statesmen, would be going on towards the ultimate crisis. It is logical, therefore, to anticipate that cheap electric power, on the principle laid down by the Commission, will do more than anything else to arrest the depopulation of the farms of Ontario and raise the status of agriculture to a new high level.

Sir Adam Beck has forecast the relation which electric power ought to have to the future of farming in this country. After outlining the service the Commission's rural lines had already rendered here and there, he said in one address: "Farm labor is expensive and scarce, and that makes farm life more burdensome. When labor is scarce and expensive anything that takes its place is a help to the farmer, and we must encourage the farmer, because agriculture takes the first place in the Province of Ontario."

CHAPTER XVII.

The Power Problem of the St. Lawrence.

Akin to the history of the early raids upon Niagara is the story of the attempts to seize the great undeveloped powers of the St. Lawrence for the enrichment of the private exploiter. At the first locality favorable for impounding the waters of that river in their course to the sea from Lake Ontario, two developments aggregating about 2,000,000 h.p. may be made at the Long Sault and in the vicinity of Morrisburg, not taking account of St. Lawrence power wholly within the Province of Quebec, which can be improved to make available two million.

In making these developments two collateral public advantages may be gained. First the waters of Lake Ontario may be raised several feet, giving a more uniform level, and second, a ship channel of a depth of thirty feet may be provided extending ocean navigation for vessels of that draft up to all ports on Lake Ontario. All vessels that can pass through the new Welland Canal could also steam from all the other great lakes and rivers to the sea. Considered as power stations these two sites divided equally between Canada and the United States would give Ontario and New York approximately a million horse-power each—a power equal to the consumption of 40,000,000 tons of coal per year, estimated at twenty tons per year per horse-power. Competent engineers have estimated the cost of the proposed ship channel and power developments at \$400,000,000 but if this estimate were doubled the interest on the outlay at 5 per cent. would be completely covered by the power revenues at an average price of \$20 per h.p. per year. If the cost did not exceed \$400,000,000 then there would be a large annual surplus from power sales alone.

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As in the case of Niagara, the St. Lawrence is an international boundary water from its head at Lake Ontario till it reaches the Province of Quebec, and consequently it comes under the treaty, before mentioned, between Great Britain and the United States. Hence the rights of navigation take precedence over power rights, but in this case the mutual rights of the two nations are specifically safeguarded by an article in the Ashburton Treaty of 1842, which provides that both sides of the Long Sault Islands and Barnhart Island "shall be equally free and open to the ships, vessels and boats of both parties."

For years past both the Morrisburg and the Long Sault sites have been an attraction to companies seeking power franchises. Since 1906 four companies with Canadian charters and eight companies with American charters, chiefly obtained from New York State, have been incorporated with the purpose of obtaining land and water rights around these localities, but chiefly at the Long Sault, where the greater power is obtainable. It is curious that in the application for most of these charters the purpose alleged as the main aim of the companies was the "improvement of the navigation" of the river, the use of the power being apparently a minor consideration. Numbers of other applications for federal charters have been made at Washington with the same solicitude for the improvement of navigation, but in most cases the applications were rejected. When the camouflage of these forms was uncovered it was found that behind the dozen or more different presentments loomed the figure—like the old cartoons of Napoleon's ghost—of a company which completely monopolizes the aluminum production of Canada and the United States and which to-day practically dictates the prices and conditions of the aluminum trade of the world.* If commercial companies had corporeal essences we

* See report on "Long Sault Rapids, St. Lawrence River," by Arthur V. White, published by the Commission of Conservation, Ottawa, 1913.

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should be forced to believe in the transmigration of souls, in so many bodies has this ghost appeared, all with the same identity of aim, the use of this international waterway for its own private purposes.

This corporation was organized in 1889 as the Pittsburgh Reduction Co. but the name was afterwards changed to the Aluminum Company of America, its Canadian branch being known as the Northern Aluminum Company of Canada, with works at Shawinigan Falls. Of its four United States plants one is located at Niagara Falls, and the other at Massena, N.Y., where it built a power canal near the Long Sault rapids. It is the sole producer of aluminum on this continent, and its output here equals six-tenths of the production of the whole world, which is now approximately 175,000 metric tons a year. This situation has an interest to the electrical industries. From its lightness aluminum is well suited as a conductor for transmission lines, having about twice the conducting capacity of copper, weight for weight, but the aluminum monarchs keep aluminum for wire at a price which just fails to encourage its large use for this purpose in the United States market. The price is lower in Canada and consequently there is a greater proportion of aluminum wire in the power lines of Canada than any country in the world, there being about 13,000 wire-miles of aluminum to 8,000 wire-miles of copper.

Aluminum is extracted by electric power from an earth known as bauxite, of which none in workable quantities has so far been found in Canada. The major part of the metal produced in Canada is not manufactured here but exported to Europe and Japan; and during the war it was important as a material for aeroplanes, machine gun parts and as an ingredient in the high explosive known as ammonal.*

Having failed to obtain charters as the improver of the

* For interesting data on aluminum and for notes on the St. Lawrence power situation, see "Conservation in 1918," by James White, Deputy head of Commission of Conservation, Ottawa.

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navigation of the St. Lawrence the war furnished the Aluminum Company with a new pretext for obtaining a hold on this power, to achieve which its affiliated companies were said to have spent \$1,750,000. This time the applicant appeared to be the St. Lawrence River Power Co. (New York Charter), which in 1917, on the plea of the urgency of increased aluminum production for war purposes, obtained from the United States Secretary of War permission to construct a submerged weir at the Long Sault, the object being to get further power for its work at Massena, N.Y. The permission for the weir was to be subject to the approval of the International Joint Commission on the treaty, but the Secretary of War gave permission to the company to build other works without any reference to the Joint Commission; and as a matter of fact without either the knowledge or consent of the Canadian Government. Although the war work was urged as the most important object, nearly a year elapsed before the company filed its plans before the Commission at Washington, and then action was claimed to be so urgent that no opportunity was given the Canadian counsel to get instructions. The Joint Commission gave an "interim order" approving of the construction and maintenance of the weir for a period of five years, or till the termination of the war, whichever should prove to be the longer time. The permit, however, was not to be taken as a decision "on any question pertaining to the right of the applicant to divert water from the St. Lawrence River."

Without doubt aluminum was needed for war purposes, and the Aluminum Company gave up its product to the Allied Governments for the same reasons that influenced many other manufacturers of war material—first because it probably wanted to help and second because if it had refused it would have been taken over by the governments and compelled to help. The cost of producing this metal by hydro-electric power being a pretty constant factor, and therefore little affected by war con-

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ditions, this company appears not to have suffered financially by the war, seeing that the New York price of aluminum, which had gradually dropped, till in 1914 it was 18.6c, was jumped to 60.7c in 1916, and down again to 33c in ton lots in 1920.

While the Aluminum Company may not concern itself with questions of international goodwill the acquisition of more water power would undoubtedly strengthen it in a monopoly which has already become a common danger. Apart from such an industrial menace, public opinion in Canada, which is distinctly opposed to the assumption of sovereign functions by a private company, has already been wounded by this act of trespass on the St. Lawrence. Further damage to the good relations of these two countries will be avoided if public men realize that electric energy has become a twin element with the use of water for navigation and that the control of such energy is now and henceforth as much a public right as navigation itself. In public economy the two uses cannot now be separated. Ontario's rights to the power of the St. Lawrence are as well established as its rights on the Niagara or the Severn; or as is the right of the Federal Government to the function of navigation.

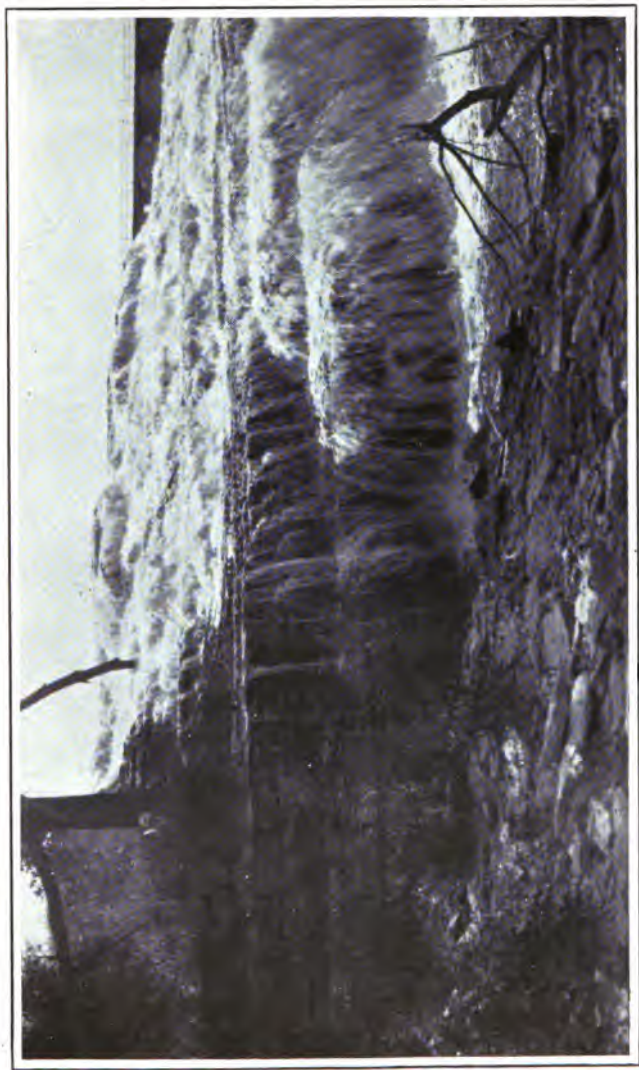
The mutual interests of the people of Canada and the United States in the inland waterways of the continent were thought to have been amicably adjusted by the Reciprocity Treaty. It was the first reciprocity treaty made by the United States, also the first negotiated in behalf of Canada. After starting out on her voyage, freighted with so much promise of good will to all nations, the good ship "Reciprocity" was destined to be wrecked in the Rapids of the St. Lawrence. It will be enlightening, therefore, to recall the causes of this disaster.

The first thing to comprehend is, that the international problems which the Reciprocity Treaty failed to settle, are now thrust back upon us for review. The interests now to be dealt

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with are far wider, more complex and demand the more enlightened treatment of a new statesmanship. But behold a new element never dreamt of during the framing of the treaty, arises to confront the new statesmen, namely, the mutual rights to the hydro-electric energy of the St. Lawrence; and from the standpoint of the next ten years who can doubt that to the people of Ontario the water power is the more vital of the two questions?

When the Reciprocity Treaty was framed the Canadian Provinces gave proof of the sincerity of their good will towards their neighbors. The improvements to the navigation of the St. Lawrence had been achieved at a cost that heavily burdened their slender resources, and now these advantages were accorded to United States vessels on the same terms as to Canadian vessels. The Canadians confidently expected that similar equality of treatment would be given to their vessels in American waters—indeed, although the navigation of the Erie Canal was considered a State right, the United States Congress undertook to use its good offices to secure like privileges to Canadian ships on that route. Congress counselled reciprocity of treatment, but the admonition of the Federal authority was received at Albany and New York almost as a joke. The truth was, that while the new American West was developing with amazing rapidity and panting for freer access to the outer world, the private transportation interests then dominated traffic both by water and land. The Erie Canal interests were allowed to take the scraps and leavings of profits while the railway corporations lived up to the theory of the time, and exacted the heaviest toll that could be taken. They could not see that while a hundred thousand tons of traffic might be turned from the Erie Canal down the St. Lawrence a million tons of traffic would flow into the expanding realms of the States west of the Great Lakes. A sordid, selfish conception seems to have mastered the transportation interests of the time, and even the new prosperity



View of Healey Falls, which supplies part of the power for the Commission's
Central Ontario System.



Another view of Healey Falls.

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which came to the border cities of New York State, such as Buffalo, Rochester, Oswego and Syracuse, as the result of the easy access to the northern markets across Lake Ontario during the Reciprocity Treaty, only excited the envy of the private transportation powers. There were times when the cost of getting grain from the Western States to the American seaboard exceeded the price which the grower got at the point of shipment. At a great convention of chambers of commerce at Detroit in 1865, where the treaty was favored, the Buffalo and other elevator interests were denounced as extortionists, whose profits in a single year covered the cost of their investment. The Reciprocity Treaty, after an existence of less than twelve years was abrogated in 1866 by the United States. From that time the hopes of Canada were inspired by a new ambition—the creation of the Canadian Confederation—and reciprocity gradually ceased to be the mainspring of Canadian policy.

And now there is a fresh spirit stirring. While the private railway corporations of the United States no longer have unlimited sway over transportation, the States west of the Great Lakes have a voice which no Congress will now attempt to silence. More than ever the Western States and Provinces need a more open channel to and from the sea, and the St. Lawrence route only can afford this free-way. Besides the Canadian western provinces, fifteen American States west of the Lakes would benefit by having direct touch with the Atlantic Ocean, and these fifteen States now possess a third of the area, a third of the population and a third of the wealth of the Union. Even now they produce seven-eighths of the iron ore; two-thirds of the coal reserves; three-quarters of the wheat, and more than half the corn and wool of the country.* They could produce still more but for lack of transportation.

That Canada has shown magnanimity towards the United States should now be acknowledged. Though the United States

* Estimates of New York *Outlook*.

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failed to admit Canadian ships on equal terms to the United States' waters as was expected, Sir John Macdonald, the first Premier of the Confederation, continued the equality of privileges to United States vessels on the St. Lawrence route after the Reciprocity Treaty was abrogated, and no Premier since his day has altered his policy.

With scandalous laxness the Dominion Government has allowed lake freight control to drift as it might till the net results of the toil of the western farmer are so diminished, and the cost of all he buys so increased by high freight that it would have been better had no pretense been made of giving cheap water freights. After spending over \$250,000,000,* not counting several millions each year for lighthouses and safeguards to navigation—the Federal Government without restriction, turns over the right of way to this marvelous system of water transport to private corporations whose power to increase the people's taxes by higher freight rates is unchecked, and whose monopoly of lake terminals is more injurious than anything yet inflicted on the Canadian people.

In 1908, before the merger of the Canada Steamship Lines was formed and before it had reached a common understanding with lake lines under control of the railway companies, the freight on wheat was 2½c a bushel from Port Arthur or Fort William to Montreal; now it is 11c a bushel. With a corresponding increase in freights going from the east to the western provinces the load of public taxation thrown on the country will be realized when it is stated that in 1916, the freighter *J. H. G. Haggerty*, charging a rate of 5c a bushel from Fort William to Port Colborne earned approximately \$273,000, or more than the cost of building the steamer, when launched in

* In a speech in the House of Commons, April 27th, 1920, Mr. J. E. Armstrong, proposing that the traffic of the inland waters of Canada be placed under the Board of Railway Commissioners, estimated the cost of our waterway improvements at over \$400,000,000.

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1914, and she expected to carry six more cargoes before the season closed. Competent authorities* state that a ton of freight can be shipped 900 to 1,000 miles by boat at the same rate as it can be carried 100 miles by rail. Whatever the difference, it will be clear from the principles set forth in the first chapter that these increases are public taxes paid by the people of Canada, and that the revenues represented in these increases over the cost of moving the freight are diverted from public to private uses when a few private individuals are allowed the uncontrolled exercise of a State function, one company alone taking over half a million a year from the Canadian taxpayers in profits on lake freight business.

During 1920 a special commission acting under the International Joint Commission has been taking evidence on the problems involved in deepening the St. Lawrence canals. This commission has already gathered a mass of valuable information, obtained at meetings held in various centres in Canada and the United States, chiefly in the lake regions and in the Western States and Provinces. Speaking generally opinion in these regions has been emphatically in favor of the navigation improvements, and the electric power developments incidental to them. In Manitoba some public bodies, while not objecting to the St. Lawrence improvements give the preference to the freight outlet by the Hudson Bay route as the first need for that province. Alone of all the States concerned, the private railway, canal, and power interests of New York oppose the project. There is not space to deal with these opinions, but reference may be made to the argument of a body representing New York transportation interests. This was that the St. Lawrence improvements would not aid ocean traffic, because of all the freight developed on the Erie Canal only about 10,000,000 tons traversed salt water, the bulk of the lake and canal freight being absorbed by inland demands. This argu-

* Interstate Commerce Commission Report.

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ment shows a misconception of the service of water transportation. As is notably the case in well canalized regions like Belgium, Holland, Northern France and parts of Germany, the cruder forms of freight such as stone, lumber, ores, coal, etc., seek the canals and rivers to which they are best adapted, but this is a public benefit not a disadvantage, as it leaves the railways free for manufactured products and the more perishable freights, such as foodstuffs requiring quicker delivery. It is the co-ordination of the waterways and railways that the people need; just now, also, it is relief from freight congestion that is wanted, and if such waterways as the New York canals could double the extent of this relief for the railways, the public advantage would not be lessened though not a ton of freight went overseas.

If, without interfering with one another's sovereignty, each country accorded the other access on equal terms to the inland waters of the whole continent, with free ingress and egress from the ocean to the upper lakes through deep water channels, a new life would come to the commerce of all those regions east of the Rocky Mountains. To bring ocean traffic direct to these regions would so freshen the arteries of trade that even such questions as the effect on the present "head of navigation" at Montreal would be forgotten in the greater good to the greater area. The annual cost of maintenance of the new sea-way might be pooled as long as the privileges were mutually extended. Apart from this enlarged freedom, the acquisition of two million horse-power of hydro-electric energy to be equally divided would be a public advantage which in time would exceed the benefits of the improved navigation.

Since this chapter was prepared a new organization, known as the Canadian Deep Waterways and Power Association, has been formed with headquarters in Toronto for the purpose of collecting and disseminating information on the benefits of deepening the inland waters of Canada to admit ocean ships.

CHAPTER XVIII.

Fiat Justitia—The Commission and the Law.

The first step taken by the municipalities towards managing their own affairs, in supplying themselves with power and light, was opposed in the case of Toronto by an injunction to restrain the city from carrying out its plans, and at frequent intervals since then attempts have been made by the private corporations to use the courts to thwart the other municipalities and the Commission in like manner. These corporations have sought to make it appear that the clauses in the Hydro-Electric Acts protecting the Commission from vexatious legal attacks were an after-thought designed to rob the companies of right and justice. The clauses, however, were in the original Act creating the Commission; and not only do they accord with like protection afforded to the universities from legal annoyances but they appear in exactly the same terms in all the constitutions of the power commissions established by the other Provinces.

Not satisfied with their actions in the Ontario courts the private companies laid before the Dominion Parliament a petition seeking to upset the power legislation of 1909; but as shown by the report of the Attorney-General of Ontario, issued under the title of "The Answer of the Government of Ontario to the Application for Disallowance of the Power Legislation of the Session of 1909," the Ontario Government stood in defence of its well-defined rights.

If such a question is approached from the standpoint of the legal controversialist, volumes might be written on either side; but if we desire to seek the righteousness of the cause the question becomes simple. Law may be divorced from righteousness,

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and when it is so divorced it becomes an instrument of wrong. To use the comprehensive phrase of St. Paul, the strength of sin is the law.

We have seen that the rates and charges collected from the people for public utilities are a form of taxation, and that a public service corporation has no other legitimate revenue except such rates. Is it not therefore a monstrous wrong for a company holding a delegated power to draw revenues from the public and then to use those very revenues in the courts to prevent the people from recovering their rights? If these vexatious actions were admitted, local self-government would be at an end.

Another misuse of the law to stultify local self-government must be pointed out. According to section 92 of the British North America Act, when the Dominion Parliament declares any work in any province is "for the general advantage of Canada" such work is by that declaration taken from the jurisdiction of the province. Under shelter of this clause, whenever a scheme is afoot which is against the interests of the province or its municipalities, the promoters, avoiding the front entrance go round by the back door through an Act of the Dominion Parliament. Here they have frequently found in time past that the more a scheme is for the disadvantage of the province the easier it is to get a declaration that it is "for the general advantage of Canada." In the sanctuary of this clause has been hatched many a project which, starting as a violation of the fundamental rights of the province or municipality, becomes a perpetuated incubus through a ruling of the Imperial Privy Council. But for the stand taken by Ontario years ago in regard to the "rivers and streams" question and later on in the power question, such an incubus would have been solidly seated on the chests of the people to-day.

We must not, however, be uncharitable to those who saw at that early date the coming era of electrical power and who

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had the courage to step in where governments feared to tread. When governments did wake up there had grown up a certain amount of toleration of the perversion then common outside as well as inside of the law courts, that a State prerogative might be dealt with as if it were the good will of a private business. But this conception is out of harmony with the divine order and with the basic principles of a commonwealth in which the elements of nature should be open on equal terms to all. These powers of nature were never created by the men who presume to fence them off, for sale on terms, but were bestowed by the Creator for the benefit of mankind at large. A private company has as much right, and no more, by virtue of a power house, to capitalize the water of Niagara, as Priestley the discoverer of oxygen would have had in patenting that element and capitalizing its future uses in science and commerce. Sir Humphrey Davy, whose discoveries in 1800 opened the field of electric lighting and power, had more ground for a perpetual franchise on the commercial uses of electric energy than have the builders of the machinery now used to put the energy into service. Robert Fulton, the designer of the first steamboat in the United States, obtained a perpetual franchise for operating steamers on the Hudson River. The claim, which was declared unconstitutional by the Supreme Court of the United States, was more reasonable than that of the power franchise holders, for they are in no case the original inventors of the primary machinery by which they utilize the hydraulic power. The power companies have the right to be paid for their bona fide expenditures on the equipment, but the element of the water power itself must be separated in the valuation. That natural resource was already there—the “gift of God,” to use the Mohammedan water-carrier’s cry—and cannot in this age be perverted into an endowment fund for the advantage of a private person or company.

A twin perversion has been built up on the theory that a pub-

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lic service when entrusted to a private person may be made the basis of a claim for good will when surrendered. Such a theory, often acted on in the past, is inconsistent with the principles of self-government. If it were conceded we would then admit that if one of the executive functions, say the administration of justice, were relegated to a private company of judges, that corporate body would sell its delegated functions for a money consideration when the State resumed its authority. Every judge would repudiate such a degrading estimate of their office and duty. The newer conception of what is due to the public from the services that are essential to the common welfare is well expressed by Franklin K. Lane, United States Secretary of the Interior, when he said: "We should guard against extortion during the use and ensure the return of the resource to the people at the termination of the license, if the people want to take it back, by refunding the net investment."

Reasoning from these premises, three axioms may be established:

1. The public may not be deprived of nature's resources for private advantage nor may these resources become an element in the valuation of a franchise.

2. The legislation of one generation cannot abolish the liberties and rights of another, and hence the theory and practice of the "perpetual franchise" must be abandoned.

3. When a self-governing state revindicates a public function entrusted to a private person such a revindication is no ground for a claim of good will.

If those engaged in promoting private enterprises with foreign capital raise the cry of "confiscation" or injury to the financial interests of Canada, when the expectations of these capitalists are not fulfilled, it is right to ask the question, "How can a man be robbed of that which he never possessed and to which he could not lay claim without an outrage upon

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the elementary rights of the community?" If an investor is so simple as to imagine that he can capitalize the powers of Heaven and Earth against the community to whom these powers rightfully belong, he should look for compensation to the promoters who promised him the impossible.

Thirty years ago when water powers were thought of as a local asset of only local use, such a theory might have been accepted, but the intervening years of advance in science and education have brought a different conception of public rights. The hydro-electric resources of the province are now regarded as a community right. The community will grant the reasonableness of a private company's claim to a return on the cost of the equipment needed to put the resource to public use, but will not admit as a private right that which no man or no company of capitalists could create. If men are to maintain their freedom they must not allow the elements of air, water and electricity to become the subject of taxation for private advantage.

CHAPTER XIX.

Review of Present Operating Conditions.

For years the antagonists of the Hydro-Electric Commission have concentrated their batteries of argument to show that it would be impossible to distribute electric power and maintain the service at the rate actually charged by the municipalities, and there was no lack of testimony from experts working under conditions of private company ownership. To show that the public ownership policy was based on a theory financially impractical, a volume was published in the United States, followed by pamphlets and shoals of editorials from partisan journals in Canada, basing their statements on the predictions of this writer. It was difficult to disprove a prophecy in advance of the period set for its fulfilment, but the lapse of time has relegated these predictions to the scrap heap of economic fallacies. Financial results which were pronounced impossible have actually been attained, and the municipalities and the Commission are more sure than ever that they are on solid ground. More than that, these results have been achieved during an era of disturbance without example in the history of civilization. A world-wide scarcity of food supplies, of the raw materials of industry, of the means of transportation and of efficient labor have coincided with a universal confusion in public finance. With such a combination of adverse events no reasonable person would have been surprised if a general and radical increase of rates had been required throughout the territory served by the Commission. That these increases, where made, have been only fractional, and that a number of the municipalities have been able to reduce their rates while others are in a position to free themselves from their debenture

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debt—or, so to speak, burn their mortgages—is an outcome that should confound the prophets of evil.

Since these pages were prepared the first volume of the twelfth annual report of the Commission, covering the year ending October, 1919, has been published. The introduction to this report gives a conservative, but illuminating statement of the enormous operating obstacles overcome by the Commission in providing power for war purposes in the first years of the conflict and then in converting this power to peace purposes when the Armistice was proclaimed in 1918. The Commission supplied power to over 400 plants on munitions, and these plants for the time took up 70 per cent. of the total power of the Commission's systems. To keep up the war work large extensions to various plants had to be made, and as the equipment was not to be had in Canada the Commission was involved in an outlay for customs duties and war taxes of over \$652,000 for imported machinery. The increasing cost and the decreasing efficiency of labor—when so many of the best men of the country were at the war—also added to the unforeseen expenses of the systems, yet with all these adverse conditions the rates fixed by the Commission at the beginning of the year were exceeded by only 3½ per cent. Forty municipalities were able to reduce their rates in this critical year, and of the twenty which had to increase rates a number of the increases were due to the interruption of power demands by stoppage of the munitions industry and before peace industries could be established.

If the power services of the Commission's Systems had belonged to private firms, they could no doubt have taken up war work and then adjusted themselves to peace conditions, but it is certain that Government compulsion would have been required in many cases; it is equally certain that the private profits on which they had been operating before the war would have been notoriously increased at the public expense, as they

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were in the United States and Great Britain under like circumstances. But the Hydro-Electric Commission made these astonishing transformations voluntarily without the slightest abandonment of its principle of service at cost, yet so swift have been the re-adaptations of its service since the war that to-day it is unable to supply the demands for its power.

The second volume of the annual report for 1919 contains some new tables of returns from the municipalities which should allay the alarms sounded by the organs of private ownership. One of these tables gives the percentage of net debt to the total assets of the hydro municipalities from 1913 to 1919. These figures show a drop in the proportion of debt from 88 per cent. in 1913 to 67.1 per cent. in 1919, and this decrease is remarkable for its regularity, the reduction of net debt being almost uniform at about 4 per cent. per year. At present 90 per cent. of the power financing is done by payments of equal annual amounts which might have been reduced from thirty or forty year debentures to twenty year debentures. With the same municipal revenues, and the same expenditures the annual reductions of the power debts have increased as above stated. These striking facts show that the original financial calculations of the Commission and the hydro municipalities, instead of being wild and reckless as alleged by their opponents, have been conservative and safe. The accuracy of the tables now presented have been tested by the auditors, and they demonstrate that the experience of the co-operative system has met every criticism of municipal ownership and operation as carried on under the Commission.

It is not unjust to point out that private lighting and power companies in Canada and United States cities in behalf of whom superior efficiency and economy is claimed, have in many noteworthy cases raised their rates at the same time that the hydro municipal corporations have kept their rates to the low levels or have actually reduced them.

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More convincing still is a tabulated statement taken from the same report for 1919, showing the financial record of the twelve municipalities who were the pioneers in the movement. Though the contracts with the Commission were signed in 1908 it was not till the close of 1912 that electric power was delivered to these twelve municipalities. The combined power load of the twelve was 16,615 h.p.; in 1919 the maximum load was 90,799 h.p. The total investment was \$13,360,822, and these obligations have been reduced to \$11,432,267, while the surplus and reserves against the balance of debt amount to \$5,550,769. Eight of the twelve municipalities now have sufficient reserves to their credit to cover all their outstanding debts, and yet, in spite of advancing costs of labor and materials reductions of power rates have been made among the twelve ranging from \$4 to \$9 per year.

SUMMARIZED BALANCE SHEET.

Municipality.	Plant.	Other Assets.
Toronto	\$10,221,824 59	\$2,504,232 48
London	1,247,591 51	465,854 74
Guelph	265,060 70	128,081 34
Stratford	811,769 71	85,643 03
St. Thomas	263,284 76	81,607 28
Woodstock	192,958 89	117,455 39
Kitchener	444,935 20	91,340 95
Hespeler	36,999 09	13,282 58
Preston	123,128 81	32,165 84
Waterloo	117,535 70	28,983 24
New Hamburg	27,423 41	9,979 94
Ingersoll	108,309 90	63,587 79
	<hr/>	<hr/>
	\$13,360,822 27	\$3,622,214 60

	Liabilities.	Reserves.	Surplus.
Toronto	\$9,436,279 32	\$3,059,205 00	\$280,572 75
London	939,315 46	411,814 91	362,815 38
Guelph	127,731 32	127,805 73	137,604 69
Stratford	213,317 36	143,810 90	35,284 48
St. Thomas	106,361 92	103,862 68	134,667 45
Woodstock	126,086 57	99,460 43	84,867 28
Kitchener	225,664 68	194,794 64	113,796 33
Hespeler	18,962 47	24,504 75	6,814 45
Preston	69,411 37	57,504 35	23,373 93
Waterloo	60,242 89	45,332 98	40,943 07
New Hamburg	17,267 80	11,537 42	8,598 13
Ingersoll	86,605 69	40,460 93	44,831 07
	<hr/>	<hr/>	<hr/>
	\$11,432,267 15	\$4,319,594 71	\$1,231,175 01

CHAPTER XX.

Sir Adam Beck.

Since the Confederation epoch no movement affecting the home affairs of Canada is causing such profound changes in legislation and economics as the creation of the Hydro-Electric Power Commission of Ontario, whose work is gaining its real momentum in the extension of the province's hydraulic energy from lighting and power services to electric railways. The reader who has followed this brief history would be lacking in human sympathy if the record closed without some personal reference to Sir Adam Beck. He is the recognized leader of this remarkable crusade against a Saracen legion, which a few short years ago held the public services as a private property right, like the old law of entail. It seemed a special Providence that brought a man of his unconquerable courage into the arena at a crisis when but for this courage and foresight the entrenched private interests dominating public offices, and acting on the timidity and mutual suspicions of municipal councillors untrained in co-operative organization, would have left the movement a wreck on the reefs with which municipal history is strewn.

Sir Adam Beck's public life may be said to have begun by his election as Mayor of London, Ont., in 1902. He was re-elected in 1903 and 1904, and in the first year of his mayoralty he was also selected as a candidate for the Legislature. This election he won and the event determined his future public career, for he became a member of the Ontario Legislature at a turn in public opinion which brought about the defeat of the Ross Administration three years later. One of the lapses

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which condemned that Government was the easy way in which the water powers of the province and the control of valuable mineral and pulpwood tracts were allowed to pass into the hands of private persons who had a keener understanding than Cabinet Ministers of the value of such concessions. When Adam Beck, as Mayor of London, attended his first meeting of the representatives of the few municipalities investigating the electric power problem, he frankly stated that he came to learn. He proved an alert pupil, and it was not long after he came to learn that he remained to lead.

During twelve years of his most self-denying exertions in the cause of public ownership he refused to accept a cent of salary, and his devotion gave an example which explains in great measure the efficiency of the civil service which has grown up to do the Commission's expanding work. Wherever a situation was in doubt, or when a "Hydro" campaign was on, he was at hand to help, and the more hopeless the prospects the more certain he was to face the foe. At Hamilton, when the question whether that city would favor a publicly-owned system of electric railways came up for a vote, outside observers abandoned hope. Every city paper opposed the plan with streams of statistics and panic-raising predictions, and adverse arguments were strengthened by a report of an unofficial "commission" of engineers, composed, of course, of gentlemen in the service of private railway companies. But more staggering still there was opposed to him the accumulated influence of a corporation having financial interests more thoroughly dove-tailed into the business and social life of the city than in any centre, perhaps, in the province. Yet, Sir Adam suddenly faced this Philistine host a few days before the campaign closed and on the day of voting, won a David's triumph by bearing away the head of the Goliath.

His battles in the Legislature were fought on the same

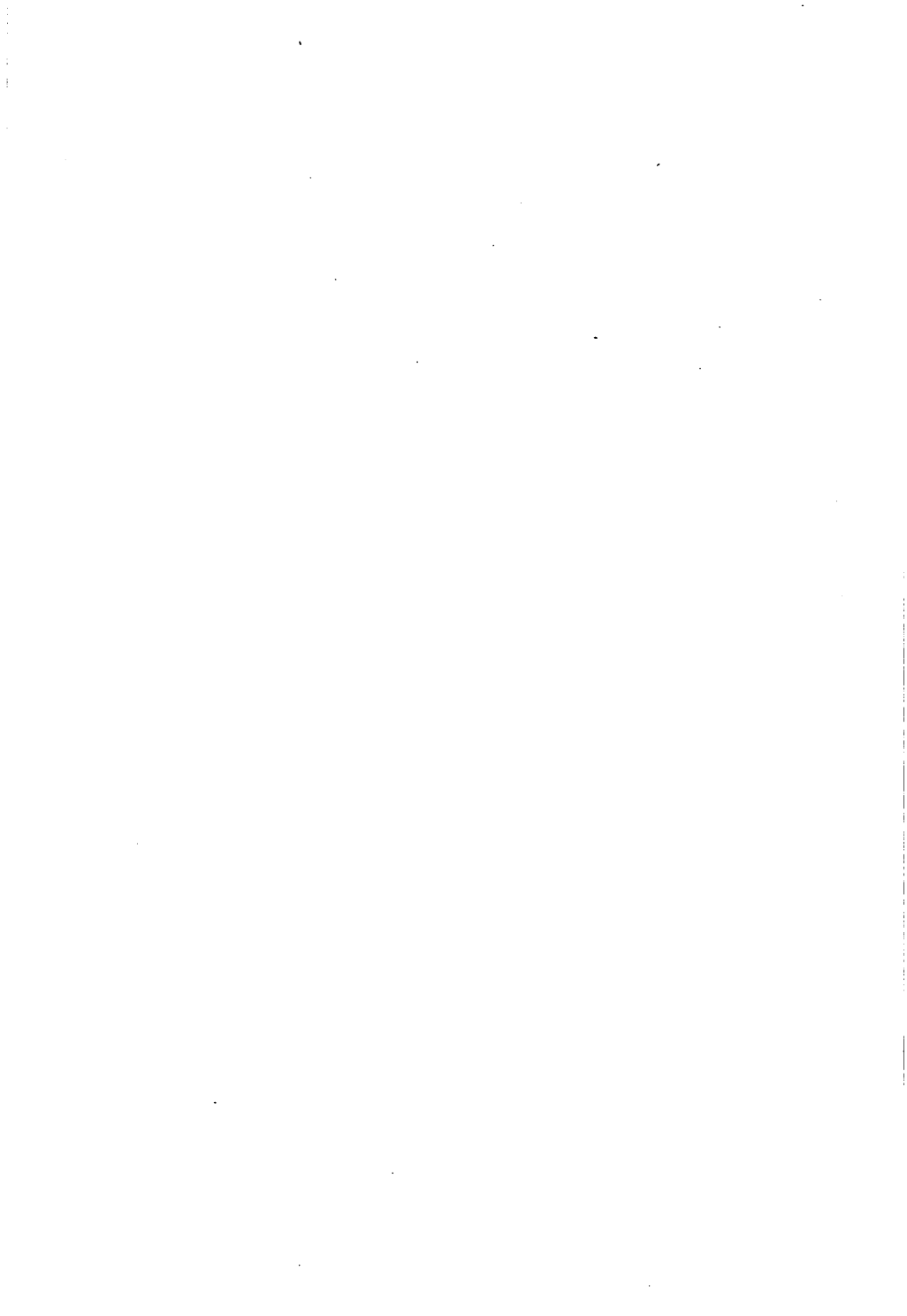
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unequal terms as those against private corporation conspiracies and against the frank and open opponents in the business community. In the period from 1903 to 1919, during which he was a member of the Cabinet, he had to contend against the attacks of avowed opponents and the precarious help of uncertain friends, and more than once these intrigues failed of success only by a miracle. Party politics played no part in his plans, and his recognition of a genuine friend in or out of the House helped him throughout many a crisis.

When the two old parties were swamped in the provincial elections of 1919 and the agricultural and labor interests took the responsibilities of control, Sir Adam was defeated in London. The defeat was due to his absorption in the electric railway campaign he was waging on his own account in eastern Ontario, and to his refusal to have outside friends come to his help. The election was an illustration of the amount of harmful tares that may be sown in a community in a night. No citizen had done more for the social welfare and for the public institutions of London than he, and no woman could have given a husband more whole-souled support in such work than Lady Beck. He and Lady Beck, for instance, had founded and spent many thousands of dollars and much time on the Queen Alexandra Sanitarium, and besides the rejuvenation of the London and Port Stanley Railway there were many civic works by promoting which he had earned the confidence of the citizens. There were many evidences, after the election, of regret by the citizens that through deft electioneering methods of the opponent they had been caught napping. As for opinion outside, that was sufficiently attested by the remarkable demonstration since the election, when representatives of four hundred municipalities met in Toronto to express their unshaken confidence in Sir Adam Beck, and their recommendation that his appointment as Chairman be made for a period of years, instead



COL. SIR ADAM BECK, KT., LL.D.,
Chairman, Hydro-Electric Power Commission of Ontario.



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of from year to year, while the municipalities should be represented with him on the Commission.

Sir Adam Beck has, of course, a hobby. This hobby is horses, his interest in which is heartily shared by his wife. They have been winners at many of the great horse shows. Even in this, Sir Adam and Lady Beck bend their enthusiasm to the national advantage, for during the war, as Director of Remounts for Canada, he rendered important service in selecting horses for the Canadian Army. Sir Adam's domestic life has been of the happiest and his affection for his wife and child is one of the finest traits of his personality. Had Lady Beck's devotion to him been less unselfish his leadership in the cause he made his own could not have been what it is.

He was presented at court with Lady Beck in 1909 and received the honor of knighthood in 1914.

The story of Sir Adam's public life is after all more eloquently recorded in the great water power developments of Ontario, in the many industries created thereby and in the new spirit he has inspired in municipal life, than can be compassed in a literary chronicle of these achievements.

What is the secret of this remarkable career? It is his absolute fidelity to what he conceives to be the public interests; and his unshakeable courage in battling for the people's rights. This influence is great, because the communities for whom he has become the champion have an instinctive perception of his fidelity and answer faith with faith.

APPENDIX

SECTION I.

The Laboratories, Shops and Inspection Departments.

In order to care for the production of certain special apparatus and to effect emergency repairs, the Commission in 1912 installed in Toronto a small shop equipped with one lathe and one drilling machine; at the same time a small testing bench was erected in another part of the building to carry out certain investigations in the performance of different types of incandescent lamps and recording and integrating meters. From this small beginning has developed the present "Service Building" of the Hydro-Electric Power Commission at Strachan Avenue, Toronto, now employing a staff of technical men and workmen numbering 200. This building, 110 ft. x 200 ft., of three stories and a basement, accommodates the present extensive Laboratories, the Production and Service Department and a portion of the Commission's Stores.

The present functions of these departments are quite varied, and developed more out of necessity than design. The voltage of the Niagara lines, 110,000, was the highest tried in Canada at that time and in the equipment of such lines many items were then required that were not obtainable in this country, hence it was better that the testing and making of these should be carried out under their own supervision. Then the transportation of supplies and protection against line troubles required a number of trucks and motor cars, and this led to the establishment of the garage service and garages in different parts of the country. The central shop at Toronto is used for

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major repairs on autos and trucks, while each of the other garage depots—at Hamilton, Belleville, and Niagara Falls—has a shop for small repairs. About 200 trucks and cars are employed, ranging from half a ton to five tons capacity. It was found that certain special office fittings could be made at these shops to better advantage and this led to the equipment of a wood working shop which also served for the making of the packing cases for shipping lamps and supplies to the municipalities. Hence the mechanical equipment now includes besides a carpentry and wood working shop, a machine shop, a repair shop and an assembling and fitting shop for such instruments and parts as can be made to advantage here. Nothing, however, is made at the shops which can be got more cheaply or of better quality outside. The advantage of this shop service has been recently demonstrated in the extensive construction work at the Chippewa-Queenston power development mentioned elsewhere.

Many new types of devices have been designed by the Commission's own experts. Heaters for the municipal central stations, air-break disconnecting switches for high voltages, relay switches for street lighting, transformer parts, bus-bar fittings, telephone relays and special line equipment are among the normal services of the shops.

The functions of the laboratories are testing, inspection and research. Under testing is included routine tests following a standardized method of procedure; special tests in which each case is treated separately and not according to any standardized method; and "approval" testing.

The routine testing is carried on in connection with many products or devices purchased under specification, such as incandescent lamps, rubber gloves, meters, etc. Routine tests and inspections are also made on cements, steel and other metals, gasoline, lubricating oils and all kinds of structural materials.

Special tests which cannot be prosecuted under a standard

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routine method are made on many new types of apparatus such as meters, insulators and many types of electrical apparatus, and on structural materials, such as paints and rust-proof compounds, building materials, fire protection devices, etc.

The approval testing is a large and important part of the laboratory work. It supplements the electrical inspection service outlined in this chapter. This work includes the testing and examination of all kinds of electrical household appliances such as irons, toasters, etc., also wire, cable, switches—in short anything electrical in common use, which may cause fire or accident. A complete routine has been worked out and this is followed by the manufacturers and the laboratories so that a continuous record of the quality of these products is maintained. The laboratory inspector visits the factories periodically and consults with the manufacturers regarding the results. This section of the laboratory is also doing a great deal of work in preparing standards for the design and construction of such devices. For purposes of consultation the Commission has appointed a committee to work with the laboratories in the carrying on of this work. This committee contains representatives of the Commission and of engineering societies, contractors, jobbers and manufacturers of the Province, and is an impartial board, appointed to discuss any questions which may arise in the carrying out of this work by the Commission.

This department also conducts inspection on many classes of material, such as steel for the construction of buildings, penstocks, surge tanks and other structures; steel rails, pipe, line construction material, and many other materials used in the construction work of the Commission. This inspection includes both the fabrication of the materials in the manufacturer's shop and the erection of the structure in the field.

The research work is very extensive in character and has to do chiefly with problems which arise in the design and

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operation of the system. Many of these problems are electrical, but some are of a mechanical and physical nature such as investigation of methods of proportioning and mixing concrete materials. This investigation has been of value in effecting great economies in the use of cement on the large construction jobs of the Commission.

Among the electrical problems investigated or still under investigation may be mentioned the following: Lightning arresters and lightning protection, insulators, high tension fuses, high tension current transformers, many theoretical studies of high tension problems, also "demand" meters, electric heating, and motion picture projectors. This department also does a great deal of special engineering work for other departments, which require calculations or studies of a theoretical nature.

The divisions of the laboratories are: The High Tension and Electrical Testing Laboratory, The Approval Laboratory, The Meter and Standards Laboratory, The Structural Materials Laboratory, The Photometric Laboratory and the Photographic Section. A Chemical division was established in 1918.

The testing equipment of these laboratories is in some respects the most complete in Canada. This is probably true of the lamp testing equipment—which is capable of tests on all classes of lamps at all voltages up to 220—and the high tension testing equipment. A new type of volt-meter, involving a principle not hitherto applied to such instruments, has been designed by the Commission's experts for measuring voltages up to 300,000. It stands 21 ft. high. Transformers are available here for testing voltages up to 400,000 volts at 60 cycles, single phase. The structural laboratory is also completely equipped with testing machines of ranges up to 200,000 lbs. and the Cement Laboratory is also completely equipped. Careful records are kept of all tests. These records are possibly as complete as any made by any cement laboratory.

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The laboratory has its own machine shop fitted with precision lathes for making and repairing delicate laboratory equipment. Much time and money is saved in having this equipment, which makes it unnecessary to return meters and other apparatus to the manufacturers to be repaired and which also makes it possible for the laboratory to construct special equipment more cheaply than it can be purchased. A great convenience results from its being available to all members of the staff. It does not attempt any production work for other departments.

The staff at present numbers about fifty. About one-third of the staff are university graduates. The Laboratory co-operates with the University of Toronto in its research programme and in 1917 a member of its staff was appointed for a period of six months to a research fellowship in the University.

Before the creation of the Hydro-Electric Commission the inspection of electrical installations was a service carried on only in Toronto and two or three other cities by the Canadian Fire Underwriters' Association. Inspection was not required by law, and was a voluntary service undertaken by the fire insurance companies to lessen the fire hazard. The only means the companies had of making it effective was by making a discriminating rate of insurance against uninspected premises. This situation was not satisfactory in the public interest, because insurance companies that were not members of the association, or individuals who were not insured at all, could not be influenced to live up to the rules of safe wiring. A fire occurring in an uninsured place would destroy the good work of a whole neighborhood.

An amendment of the Hydro-Electric Act passed in 1912, required all municipalities in Ontario, whether participants in the Hydro-Electric system or not, to appoint inspectors of electrical work within their own boundaries. A group of muni-

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cipalities might combine to have an inspector in common, but in such cases there was complaint of favoritism and complaint also over the apportionment of the costs. As each inspector carried out his own ideas there was great variation in the quality of the wiring, etc., approved by the different inspectors, while the costs of inspection increased. For the sake of uniformity, efficiency and economy the municipalities agreed to transfer the inspection service to the provincial commission.

An Electrical Inspection Act was passed by the Ontario Legislature in 1915 and that Act applied to all wiring whether outside or within the areas served by the Commission. In considering the means of administering this Act it was thought best to make use of the machinery already provided in the Hydro-Electric power areas, and for this reason the administration of the Act was committed to the Commission, and confirmed by amending Acts.

The first result was that the inspection service which would have required approximately 200 inspectors under the local system is now more uniformly done by 54 inspectors, who carry out uniform rules, and render a service which has been regarded by both municipalities and the public as more satisfactory. The operation of the new system proved so efficient that the insurance companies accepted the Commission's system and abandoned their own.

The Commission's engineers had been devoting much study to the improvement of existing appliances and to new apparatus intended for the better protection of life, and here, for the first time in the history of the regulation of electric wiring and installations, elementary consideration was given to the saving of human life as well as the saving of property. The case of a lady who met her death through a short circuit from an electric heater in a public institution led Mr. Justice Riddell and Hon. W. Nesbitt to suggest that, for the better protection

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of life, electrical equipment should be under the control of the Commission.

With the approval of the Lieutenant-Governor in Council the Commission is empowered to make regulations as to the design, construction or operation of appliances for the generation, transmission, distribution, connection and use of electrical energy whether by a commission, municipal corporation, private company or individual. The authority to inspect covers any railway, lighting or power company or any place where electric current is used, and the Commission may order such changes in the works as are necessary to protect the public or workmen or to protect premises from danger by fire. The costs of inspection are partially paid by the fees or fines, and it may be noted that the scale of fees is as low as that of any other province and lower than most states of the American union. Failure to comply with an order of the Inspection Department after due notice is punishable by fines varying from \$10 to \$500. From premises in which there is defective wiring and where a remedy cannot otherwise be obtained, power may be disconnected. Nothing in the Act relieves a corporation, company or individual of liability for damages for any defect in machinery or wiring, or on account of loss due to disconnections made by order of the Commission.

A set of regulations has been prepared by the Inspection Department as a guide in construction methods and requirements in operation. For the protection of the public the Commission now requires that all machinery and appliances used where the pressure exceeds 10 volts shall be passed upon by the department, as to its design and construction before it may be sold within the province. Permits for wiring and installing must be taken out before work is commenced, and no connections for service of current shall be made till a certificate is given from the department.

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Regulations are framed governing the installation of generators, storage batteries, switchboards, lightning arresters, transformers, motors, electric cranes, electric signs, wireless telegraph apparatus, electric railway plant including the cars and all house, factory and office fittings.

The permit system has improved the status of the electrical contractor by helping to eliminate the careless and incompetent.

In the department's printed regulations, helpful hints and illustrations are given, with tables and data for men engaged in installing machinery and fixtures; and instructions are given for restoring persons suffering from electric shock or burns.

SECTION II.

Water Power Leases.

During the latter half of the last century there was a long conflict between the Ontario and the Dominion Governments over the control of the rivers and streams, but those differences have been cleared away by judgments of the Imperial Privy Council, so that water power developments, except those incidental to canal works, etc., are left to the authority of the Province. Navigation is a prerogative of the Federal Government, and consequently no water power development may be made either by private companies or the provincial government so as to interfere with river navigation without the consent of the Dominion Government; and, if a stream has been used for log-driving purposes, the lessee, in making a power site, must provide for safe passage of logs and timber. The principal regulations governing the development of water powers in Ontario are as follows:—

A private applicant for a power privilege must first file in the Department of Lands, Forests and Mines a plan and field notes of an Ontario Land Surveyor, showing the land and the power required; and an engineer's report must be filed showing the height of the fall, the height of dam, the estimated capacity and the increased water level to be caused by the works; also the form of energy to be produced—hydraulic, electric, compressed air, etc.,—and the nature of the industrial establishment to be carried on, with proof of the financial ability of the applicant to complete his plans. The Minister may require that the plans be submitted to the Hydro-Electric Commission for approval, and the work may not be started till such approval is given.

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The term of water power lease is twenty years, the lessee having the right of renewal for two successive terms of ten years each, on conditions fixed by the Minister. The annual rental to be charged is graded according to the number of horse power to be developed (the average being less than a dollar per horse power per year) the applicant depositing \$500 or more as a guarantee that conditions shall be fulfilled. If there is a surplus of water beyond that required by the applicant, other parties must be permitted to use it on terms laid down by the Commission.

On expiration of a lease the privilege reverts to the Crown though where permanent buildings have been erected the lessee may, on report of the Commission, be compensated therefor. A water power lease may be cancelled for non-compliance with the terms and conditions of the lease, or upon neglect of the lessee, for the period of one year, to produce power.

Renewal of a lease does not necessarily perpetuate the terms of the original lease, but new terms may be fixed by the Minister after a report from the Commission. Where a larger development is required at or near the site expropriation proceedings may be taken under the Arbitration Act.

These regulations are not applied to water privileges having a capacity of less than 150 horse power at low water.

Where a water power privilege is sought by a municipality for the purpose of supplying power, light or heat to its inhabitants, leases may be granted on any terms recommended by the Commission, and, as before explained, the Commission may itself create, or acquire, and operate any power site or power installation at present in private ownership, with or without the consent of the owner.

While there is no ban upon the acquisition by a private individual of a water power, public opinion does not favor the operation of such privileges for private profit. Water

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powers are more and more regarded as a great natural resource intended for the general benefit, and the authority of the Hydro-Electric Commission keeps full pace with this growing current of public opinion. At all events no private corporation, however wealthy, can hereafter monopolize such assets for direct profits on the scale permitted before the creation of the Commission.

The rates which a licensee may charge consumers may be prescribed by the Commission.

All leases are subject to any general regulations to be subsequently made by the Lieutenant-Governor in Council.

SECTION III.—THE POWER SYSTEMS.

The New Niagara Generating Station.

As an introduction to the appended sketch of the engineering features of the various power systems operating under the Commission, a few general facts concerning the new Niagara generating station, known as the Queenston-Chippawa development, will be of public interest.

When completed this will be the largest hydro-electric generating station in the world and probably the most efficient. The machinery and construction plant has been provided by the Commission, and the construction carried on under its own engineers, who employ both skilled and unskilled labor. The pay roll has varied from 1,500 to 2,000 and for the accommodation of the men a village of eighty houses and shops has been established on the land acquired by the Commission for the permanent works. The provisioning of the men is done in great part by food supplies raised on the Commission's farms.

The material from the canal, between the Chippawa (or Welland) river and the power house, a large part of it solid rock, is being removed by ten electric shovels, some of which are the largest in the world. These weigh from 300 to 375 tons, have a motor capacity of 750 horse power and are capable of excavating 3,000 to 5,000 cubic yards of earth per ten-hour day. The largest shovels can pick up 8 cubic yards, lift the load 70 feet, dump into cars, and swing back for another load within one minute. A representative of the *Engineering News-Record* states that more earth-moving machinery is in operation here than on any work since the building of the Panama canal. Rock crushers are used so that material may be provided for

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reinforced concrete required for portions of the work and for the railway bridges over the canal. Practically all the plant is electrically driven, and on the 55 miles of track required in the construction work there are more electric locomotives than at present on all the railways in Canada.

The survey for this work was made in 1914, and if the undertaking had been started when a favorable report was first made, it would now have been finished, and there would have been no acute shortage of power, as complained of at present.

The story of the Queenston-Chippawa enterprise is instructive as an illustration of the development of the water powers under public ownership, compared with the inevitable outcome under private company domination. At the generating station of the new works there will be an effective head of 305 feet and, as the yield of power is in proportion to the height through which the water falls, each cubic foot of water per second will give 30 horse power, as compared with about 15 horse power produced by the present plants operating at the Falls. The treaty between Canada and the United States allots the water on each side not by the horse power actually obtained, but by the volume of water diverted to the power houses. So it follows that if the whole treaty allotment of 36,000 feet per second on the Canadian side were used at the Queenston-Chippawa plant over a million horse power would be obtained, whereas the total energy available to the three private companies is 405,000 horse power. These four generating and transmitting companies were capitalized at about \$46,782,000; the estimated cost of the Queenston-Chippawa development—at a time when material and other costs have about doubled—is \$30,000,000, so that the relative economy for each unit of power can be easily figured.

It should therefore be beyond dispute that if the policy

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and the methods of development of the Hydro-Electric Commission had been carried out at an earlier date, the waste of a vast amount of private capital would have been saved, and the people of the Province would have had power at an unprecedentedly low cost and without fear of the famine which subsequently ensued, and still obtains.

During the past spring the Chippawa works were greatly hampered by strikes among the laborers for higher wages. To have granted the demands would have meant an addition of \$1,500,000 or more to the cost of the finished work. In the interests of the Province this the Commission refused to do, and for a time the works were closed. The interval was used to obtain still more effective electrical power equipment and as a result, it is expected that notwithstanding the delay caused by the strike it will still be possible to have at least two units installed and in operation by the fall of 1921, to make good the shortage prevailing throughout the territory of the Niagara system.

NIAGARA SYSTEM.

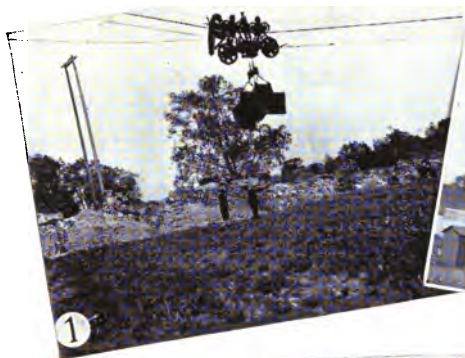
Queenston-Chippawa Development.—The completion of this development, now under construction by the Hydro-Electric Power Commission will result in the installation of the largest hydro-electric plant now existing. The physical features of the development will extend from Hog Island at the mouth of the Welland River, some two miles above the Falls, to a point on the Niagara River one mile above Queenston known as Smeaton's Curve, and will include an intake, hydraulic canal, control works, forebay, headworks and generating station. From the intake at Hog Island, the canal, approximately 12 miles long, will convey water to the forebay located immediately above the headworks, the latter being located on the top of and near the edge of the Niagara Gorge. The first 4½ miles of the canal,

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from Hog Island to Montrose, will be part of the Welland River, now emptying into the Niagara River, but whose flow will be reversed by means of dredging the necessary down grade as far as Montrose, from whence the canal will diverge from the river across country to the forebay. The latter will be 1000 feet long and will widen out from canal width at its beginning to a width of 500 feet in front of the headworks. The canal will be cut largely through rock and in part through earth. The excavation for the forebay, headworks, penstocks, and generating station will be in solid rock.

From the headworks water will be conveyed through nine steel penstocks, 16 feet in diameter at the upper end and 14 feet in diameter at the lower end, and one 5-foot diameter service penstock, all laid in trenches excavated in the gorge face and leading to the generating station in the gorge below. Each of the nine penstocks will supply a turbine of 52,500 horse power capacity under a head of 305 feet, when running at 187.5 revolutions per minute. The turbines will be of the vertical single-runner type. They are the most powerful as yet designed and constructed, and will each be direct connected to a three phase 25 cycle generator, delivering power at 12,000 volts. A feature of the turbine foundations will be the provision of sub-basement tunnels, which will permit of the lowering and removal of the turbine runners for renewal or repairs, thus obviating the usual necessity for dismantling the generator in order to remove the turbine runners. The generators will each be provided with an individual direct connected exciter. The initial installation will consist of four 52,500 horse power units, the remaining units being added from time to time in line with future power demands. All power transmitted from this plant will be carried at 110,000 volts.

The Ontario Power Company.—This development, situated on the Niagara River, was the pioneer of the extensive develop-



(1) Cableway Excavator in Welland River. (2) Cableway Excavator from East Bank of Welland River. (3) Site of the World's Largest Power House. (4) Drilling wall of Forebay. (5) Dredge loading scow opposite Hog Island, at the mouth of the Welland River.



Electric shovel operating in rock. (2) Electric shovel excavating earth and loading cars. (3) Power Canal, looking north from N. S. & T. Ry. bridge. (4) Power canal from Bowman's Ravine. (5) Electric shovel at work (these shovels are the largest in the world). (6) View through the Power Canal from the floor of the

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ments installed on the Canadian side at Niagara Falls. It was commenced in 1902, the initial installation consisting of an intake, outer forebay, screen house, inner forebay, gate house, an 18 foot diameter steel main conduit 6,500 feet long terminating in an overflow, a six unit power house and a distributing station. The intake, forebay, screen and gate houses were completed for the ultimate development, the gate house being arranged to serve three main conduits. The three above mentioned structures are built entirely of concrete reinforced where necessary with steel, the superstructures presenting a massive and handsome appearance. The overflow building has a concrete substructure, the superstructure being of stone and designed to harmonize with the park surroundings. The distributing station is more ornate in character, being built of brick and cut stone. Water for the turbines is diverted from the Niagara River above the Falls into the outer forebay by means of a submerged concrete spill dam, reaching out from the Canadian shore, which also forms a discharge for ice or débris entering the forebay through its intake. The latter is 600 feet long and is constructed both as a wall of submerged arches and also as an ice fender.

Subsequent additions to the plant, prior to 1917, in which year it was taken over and operated by the Hydro-Electric Power Commission, covered the addition of a second main conduit running parallel to and having the same sectional area as No. 1 conduit, but constructed of reinforced concrete with an oblate section, and terminating in a reinforced concrete differential surge tank, the external features of which bear imposing architectural treatment. Eight additional units were installed, together with a central exciter power plant.

The last final extension to the plant, completed early in 1919, was designed and constructed by the engineering staff of the Hydro-Electric Power Commission and consisted of a third main conduit 13 feet 6 inches diameter, running parallel to

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conduits Nos. 1 and 2, built of wood stave and terminating in a steel differential surge tank. Two additional units were installed and set ten feet lower than the preceding units, thus securing additional head. This extension was installed primarily as an emergency war measure, to meet the urgent and abnormal demand for power for the production of munitions and war materials.

Summarizing the unit capacity under 180 feet net head, the first seven turbines develop 11,800 horse power each, the next five 15,000 horse power each, the next two 16,000 horse power each and the last two 18,000 horse power each, making a total of 225,600 horse power installed capacity. When fully loaded, with all units in service, it is possible to carry approximately 210,000 electrical horse power. This constitutes the largest output of power developed by any single plant up to the present time.

Each turbine is direct connected to a 12,000 volt, 3 phase, 25 cycle generator, the sixteen generators having a total capacity of 179,000 K.V.A. Each is excited with an individual motor generator set. The latter are served from the central exciter plant, which consists of two complete motor-turbo-generator sets, each including a turbine of 1600 horse power, served by a 4 foot diameter penstock from No. 2 conduit driving a 900 K.W., 3 phase, 25 cycle alternating current generator and a 600 horse power induction motor capable of carrying the full load of the generator for a period of ten minutes and intended as an instantaneous relay on the turbine. Either main exciter unit is capable of carrying the entire exciter load of the plant. The turbines are all provided with relief valves and are regulated by automatic hydraulic pressure governors. Pressure rise and fall in the main conduits is taken care of by the overflow and surge tanks above mentioned. The generators are cooled through the medium of air ducts from the front and rear walls. The

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power house drainage system culminates in a common sump from which water is discharged by motor driven centrifugal pumps. Immediately in front of the overflow and surge tanks the three main conduits form distributors, from which steel penstocks varying in diameter from 9 feet to 10 feet 6 inches lead down through shafts excavated in solid rock to the turbines in the power house. Each penstock is furnished with a controlling valve located in a valve chamber immediately underneath the distributors. These valves are all electrically operated, and, in common with all other power operations in connection with the plant, can be controlled from the main control room in the distributing station. The distributing system, from whence the output of the power house is controlled, is located on the hill above the Gorge, and overlooks the Falls. A system of cable tunnels conveys the generator output from the power house to this building, which includes the Executive Offices of the Ontario Power Company, and from which energy is transmitted over the Niagara System. Access to the power house, valve chambers, and distributing station is obtained by means of tunnels and elevator shafts from an entrance building, reached from the roadway above the Gorge, in Queen Victoria Niagara Falls Park.

Erindale Development.—This development, installed in 1910, is situated on the Credit River about 8 miles above Lake Ontario, was taken over by the Hydro-Electric Power Commission in 1917, and included in the Niagara System. The plant includes an earth dam with core wall, 700 feet long and 35 feet high, from which a 900 foot concrete lined tunnel 12.5 feet diameter conveys water to a storage tank immediately adjoining the power house. From the tank water is supplied to two turbines developing 1,000 horse power each under a 50 foot head, of the single runner single discharge type, the runners being located in the bottom of the tank. Each turbine is direct connected to

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a 600 K.W., 3 phase, 60 cycle generator, the latter each having a 60 K.W. belted exciter. The turbines are regulated by oil pressure governors.

SEVERN SYSTEM.

Big Chute Development.—This development is situated on the Severn River at Big Chute, 9 miles from the mouth of the river. It was built in 1909, by the Simcoe Railway and Power Company and purchased by the Hydro-Electric Power Commission in 1914. The development then included three units having a total capacity of 3,300 horse power served by one penstock. The Commission has recently developed the full capacity of the plant by the addition of a second penstock and one 2,300 horse power unit, the total capacity being 5,600 horse power under a head of 58 feet. The river above the development has a drainage area of 2,265 square miles. Storage is obtained on Lakes Simcoe and Couchiching. A hydraulic canal, 350 feet long, conveys water from the river to the headworks. From the latter two steel penstocks 9 feet diameter and 150 feet long convey water to the power house. The latter is built entirely of concrete. The three original turbines are of the double-runner horizontal type in cylindrical casings, each of 1,100 horse power and direct connected to 900 K.V.A., 3 phase, 60 cycle generators. The fourth turbine is of the double-runner horizontal type in spiral casing with centre discharge, developing 2,300 horse power and direct connected to a 1,600 K.V.A., 3 phase, 60 cycle generator. Excitation is provided by two 100 K.W. 125 volt generators, each direct connected to a 200 horse power turbine. Regulation is provided by automatic hydraulic governors. A steel surge tank terminates the penstocks which are inter-connected at the power house. A transmission line of 103 miles long conveys energy from the power house at 22,000

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volts to Waubaushene, Penetanguishene, Barrie and Collingwood, the system being tied into the Eugenia System at Collingwood and also to the Wasdell's Falls System.

WASDELL'S FALLS SYSTEM.

Wasdell's Falls Development.—This development, situated on the Severn River three miles below Lake Couchiching, and completed in 1914, is notable for its low head and as being the first plant designed and constructed by the Hydro-Electric Power Commission. It includes a stop-log type concrete dam, power house and tail race, the power house forming a westerly extension of the dam. The drainage area of the river above the development is 2,080 square miles. Storage is obtained on Lakes Simcoe and Couchiching, the levels of which are regulated by the Department of Railways and Canals. The dam has a length of 110 feet, is 14 feet high, and is provided with six sluiceways, a spillway and a log chute. The power house is built entirely of concrete and contains two units developing a total capacity of 1,200 horse power. These are of the vertical shaft, double-runner, double-discharge type, set in open flumes, each direct connected to a 400 K.V.A., 3 phase, 60 cycle generator. Excitation is provided by one 20 K.W. turbine driven and one 30 K.W. motor driven exciter, and regulation by oil pressure governors. A transmission line 46 miles in length conveys energy at 22,000 volts from the power house to Beaverton, and Cannington, and the Severn System.

EUGENIA SYSTEM.

Eugenia Falls Development.—This development, designed and constructed by the staff of the Hydro-Electric Power Commission of Ontario, was completed for an initial installation of 4,800 horse power in 1915, and is of special interest as operating

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under a head of 550 feet, one of the highest in Canada. It is situated on the Beaver River, about 8 miles from Flesherton, the latter being on the Toronto-Owen Sound branch of the Canadian Pacific Railway. A storage area of 1,600 acres with a capacity of 750 million cubic feet, is created by two dams, one of concrete and the other of earth with a puddle core fill, and riprapped on the upstream side. The drainage area above the development is about 76 square miles. From the storage reservoir, water is conveyed successively by a hydraulic canal 5,000 feet long to the head works, thence by a 46-inch wood stave pipe 3,350 feet long to a head-block and from the latter by a 52-inch steel penstock, 1,560 feet long, to the power house. A differential surge tank is installed at the junction of the wood stave and steel pipes. The power house substructure is of concrete, reinforced where necessary, and the superstructure of brick. The ultimate capacity of the development will be 12,800 h.p., for which the present pipe line will be duplicated. The present turbine capacity is 8,800 h.p., the first two units being of 2,400 h.p., and the third, installed in 1918, of 4,000 h.p., the latter unit being fed from a cross-over, ultimately to be connected to the second penstock, from the present penstock. The 2,400 h.p. units are each direct connected to a 1,410 K.V.A., 3 phase, 60 cycle generator and the 4,000 h.p. unit to a 2,810 K.V.A., 3 phase, 60 cycle generator, each provided with a 125 volt direct connected exciter. The turbines are regulated by oil pressure governors and are provided with relief valves. Transmission lines radiate from the power house to Owen Sound, Orangeville and Chester. The total length of these lines is 176 miles, of which 47 miles are at 4,000 volts and the remainder at 22,000 volts, the whole comprising the Eugenia System, which is interconnected with the Wasdell's Falls and Severn, and may later also be connected with the Niagara System.

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THUNDER BAY SYSTEM.

Nipigon River Development.—This development is under construction by the Hydro-Electric Power Commission on the Nipigon River at Cameron Falls, and situated about 15 miles north of Nipigon Village, the latter being on the Canadian Pacific Railway. The Nipigon River, flowing out of Lake Nipigon, which has an area of 1,530 square miles, has a drainage area above the development of 9,100 square miles. The development will include a gravity dam having five sluiceways, a headrace 365 feet long, leading directly from the river to the power house, and a tailrace about 1,000 feet long. The latter will parallel the river at its lower end and will be separated therefrom by a rock-filled crib. The head-works and power house substructure will form a single concrete structure, reinforced with steel where necessary. The head-gates will be arranged in groups of three per unit, the centre gate being of the rolling type and the outer gates of the sliding type. In their operation the rolling gate will be raised first, thus relieving the sliding gates of water pressure. Each group of gates will control the openings of a three-way penstock culminating in a one-way entrance to the turbine scroll cases. The penstocks, scroll cases and draft tubes will be moulded in concrete. The power house superstructure will also be of concrete. The ultimate development will comprise six units. The turbines will be of the vertical shaft, single runner type, developing 12,500 h.p. each, under a head of 72 feet, and will be regulated by hydraulic governors. They will be direct connected to 10,600 K.V.A., 3 phase, 60 cycle, generators, each having an individual exciter. Two units will be installed initially and the remaining four in line with future power demands. The ultimate capacity will be 75,000 h.p. Energy will be transmitted to the Port Arthur System at 110,000 volts.

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NIPISSING SYSTEM.

Nipissing Development.—This development, situated on the South River, near the village of Nipissing, and formerly owned by the Electric Power Co. (Central Ontario), utilizes a mean flow of 225 cubic feet per second, the drainage area of the river being about 300 square miles. From a concrete stop-log diversion dam, a hydraulic canal 900 feet long ends in a headworks and creates a pondage reservoir of 100 acres. From the headworks a wood stave pipe 2,300 feet long and 6 feet diameter, with an extension of a short run of steel penstock to the power house, conveys water to two turbines, each of 800 h.p. These are of the single runner double discharge type with scroll casings, and are direct connected to 450 K.W., 3 phase, 60 cycle generators, the latter each having a 125 K.W., 125 volt, direct connected exciter. A 37.5 K.W., 125 volt motor driven exciter is also provided. Regulation is obtained by hydraulic governors. The total capacity of the plan is 1,600 h.p., to be ultimately increased to 2,800 h.p. The power house substructure is of concrete and the superstructure of brick. A differential surge tank is installed at the junction of the wood stave and steel pipe line. Twenty miles of 22,000 volt transmission line convey energy from the power house to North Bay with a four-mile tap to Powassan, and 2.5 miles of 2,200 volt line supply Nipissing Village.

MUSKOKA SYSTEM.

South Falls Development.—This development is situated about seven miles from the town of Gravenhurst, on the south branch of the Muskoka River, the latter having a drainage area of 677 square miles above the development. The plant was formerly owned by the Municipality of Gravenhurst, and built

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in 1909. It was taken over by the Hydro-Electric Power Commission in 1915, by whom it was remodelled and enlarged. It includes a concrete stop-log type dam, 80 feet long and 20 feet high, having three sluiceways and a log slide. Two penstocks extend from the headworks, which are at the south end of, but separate from, the dam, to the power house. The power house has a concrete substructure and a brick superstructure. The penstocks are about 1,000 feet long, one being of wood stave, 60 inches diameter, and the other of steel 36 inches diameter. Provision is made at the lower end of the former for the installation of a future surge tank. The ultimate capacity of the plant will be 6,000 h.p. The present capacity is 1,750 h.p. under a head of 102 feet, developed by two units, one of 750 h.p., having a turbine of the horizontal, double-runner, double-discharge type in cylindrical casing, and direct connected to a 450 K.V.A., 3 phase, 60 cycle generator, and the other 1,000 h.p., of which the turbine is a horizontal single-runner single discharge type in cylindrical core casing, direct connected to a 750 K.V.A., 3 phase, 60 cycle generator. Three exciters are installed, respectively turbine, motor and belt-driven. Regulation is provided by one mechanical and one oil pressure governor. Energy is transmitted from the power house over seven miles of 6,600 volt line to Gravenhurst, and over 26 miles of 22,000 volt line to Huntsville.

RIDEAU SYSTEM.

High Falls Development.—This development is under construction by the Hydro-Electric Power Commission on the Mississippi River, about half a mile above Dalhousie Lake. A drainage area of 450 square miles and storage facilities in the lakes above afford a mean flow of about 280 cubic feet per second. From a concrete gravity dam having four stop-log sluiceways,

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water will be conveyed through a hydraulic canal about 250 feet long to a headworks and from thence by a wood stave pipe 10 feet in diameter and 320 feet long to a power house built entirely of concrete, in which will be installed three 1,200 h.p. units. The turbines will be of the horizontal, double-runner, double discharge cylindrical casing type. Of these, one will be direct-connected to a 875 K.V.A. generator and the other two each to two 350 K.V.A. generators. Three belt-driven 25 K.W. exciters will be installed and regulation will be provided by one mechanical and two oil pressure governors. The total capacity of the plant will be 3,600 h.p. under a head of 85 feet. Energy will be transmitted to the Rideau System at 26,400 volts.

CENTRAL ONTARIO SYSTEM.

The system now known as the Central Ontario System was purchased in 1916 by the Province of Ontario direct and afterwards transferred to the Commission to operate. It was originated by a private corporation known as the Electric Power Co., Ltd., whose promoters in the course of a few years reached out not only for all the power rights it could acquire along the Trent River Valley and Trent Canal—including the power sites at Healey Falls, the power dam at Peterboro, formerly controlled by the Auburn Woolen Co. (Auburn Development), Fenelon Falls, Trenton, Campbellford, and Frankford, but a development on the South River quite separated geographically from the Trent System. It also had rights to over a dozen power sites of larger or smaller capacity not as yet developed; and at the time of the purchase by the province the company had acquired by lease or purchase over thirty utility services in its territory, including gas works, water works and a street railway system at Peterboro. For operating purposes all these services were transferred to the Commission when the power sites were taken over.

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Healey Falls Development.—This development is situated at dam No. 13 of the Trent Valley Canal, and about six miles above Campbellford. The drainage area of the river above the plant is 3,515 square miles. In common with the other powers of the Central Ontario System, this plant enjoys a very regular river flow owing to the great natural storage obtaining throughout the watershed, the levels of the larger lakes of which are controlled by the Department of Railways and Canals. The development includes a short headrace 250 feet long, leading from the Trent Canal to a concrete gatehouse from which three steel penstocks 12 feet diameter and 450 feet long lead to the power house. The substructure of the latter is of concrete and the superstructure of brick. The building houses three units, developing a total capacity of 16,800 h.p. under a head of 76 feet. The turbines are of the double-runner, centre discharge, horizontal type in cylindrical casings, each of 5,600 h.p. and direct connected to three 3,750 K.V.A., 3 phase, 60 cycle generators. Two 160 K.W., 125 volt exciter, one turbine and one motor driven, are provided. Regulation is provided by oil pressure governors. Energy is transmitted to the Central Ontario System at 44,000 volts, the transmission mileage of this system including 372 miles of 44,000 volt line, 15 miles of 11,000 volt line, 16.4 miles of 6,600 volt line and 52 miles of 4,000 volt line.

Auburn Development.—Just north of Peterborough, this development is situated on the Otonabee River at Dam No. 18 of the Trent Valley Canal System. It includes an easterly extension of the dam forming a four sluiceway intake, admitting water to a headrace 1,200 feet long and 150 feet wide, a series of open flumes, power house, tailrace and separate transformer house. A retaining wall, partly of concrete and partly of earth fill, divides the headrace from the Otonabee River. At the end of the headrace a spillway and icerun is provided to

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discharge into the river. Water from the headrace is conveyed directly into five open flumes in which are installed three main turbines and one exciter turbine. The former are of the quadruple, double-discharge, horizontal type, of 950 h.p. and direct connected to 625 K.V.A., 3 phase, 60 cycle generators. The latter is direct connected to a 90 K.W. 125 volt exciter. A second exciter, motor driven, of the same capacity, is installed. Regulation is maintained by automatic hydraulic governors. The total capacity of the plan is 2,850 h.p. under a head of 18 feet. A travelling emergency gate enables any individual turbine to be shut down. A tailrace, enclosed by a part concrete wall and part cribwork, discharges directly into the Otonabee River. The power house substructure is of concrete. The superstructure of both power and transformer houses is of brick. From the latter energy is transmitted to the Central Ontario System at 44,000, 2,400 and 6,600 volts.

Fenelon Falls Development.—This development is situated at Dam No. 30 of the Trent Valley Canal System. One end of the dam forms a three sluiceway intake for a forebay 200 feet long, leading to the power house, where two turbines, each of 700 h.p. capacity under a 24-foot head, are direct connected to 400 K.W., 3 phase, 60 cycle generators. One turbine driven exciter is installed and regulation is provided by mechanical governors. The development will be reconstructed in the future, when the load demands of the system demand the additional power. The electrical output feeds into the 44,000 volt Central Ontario System.

Trenton Development.—This development is situated at Dam No. 2 of the Trent Valley Canal System, about five miles below the Frankford development. The power house is built at the east end of the dam. An intake extending in line with the river bank and at right angles to the east end of the dam conducts water to a forebay, which in outline forms the quad-

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rant of a circle. From the forebay water is conveyed directly into wheel pits forming part of the power house substructure, in which four 1,400 h.p. turbines of the double-runner, single discharge, vertical shaft type, are placed. These are direct connected to 937 K.V.A., 3 phase, 60 cycle generators. The total capacity of the plant is 5,600 h.p. under a head of 20 feet. The generators are served by two 75 K.W., 125 volt, exciters, one motor and one turbine driven, the turbine for the latter being installed in the remaining wheel pit. The turbines are regulated by oil pressure governors. The power house substructure is of concrete, and the superstructure of brick. A stony gate, operated by a travelling gantry, controls the wheel pit openings. Tail water discharges directly into the Trent River. The transformer station, with a brick superstructure, is situated east of the power house, the Frankford Road running between the two buildings. The transformer station receives the 6,600 volt output from the Frankford development and transmits this and the output of the Trenton development to the Central Ontario System at 44,000 volts.

Campbellford Development.—Six miles below Healy Falls, this development is situated at Dam. No. 1 of the Trent Valley Canal System. A five sluiceway extension of the dam forms the intake of a headrace about 1,000 feet long and 150 feet wide, from which water is conveyed directly to the wheelpits of five turbines of the double-runner, single-discharge vertical type, each having a capacity of 1,000 h.p. A total capacity of 5,000 h.p. is developed under a head of 23 feet. The turbines are each direct connected to a 750 K.V.A., 3 phase, 60 cycle generator. Excitation for the generators is provided by two 60 K.W., 125 volt exciters, one being turbine and the other motor driven. Two 17.5 K.W. belted exciters are also installed as spares. Regulation for the turbines is provided by oil pressure governors. A sixth opening in the power house substructure

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ture forms an icerun. The power house substructure is of concrete and the superstructure of stone. Tail water from the plant discharges directly into the Trent River. Energy is transmitted at 44,000 volts to the Central Ontario System.

Frankford Development.—This development is situated at Dam No. 6 of the Trent Valley Canal System. A three sluiceway intake at the east end of the dam conveys water to a short forebay which, in turn, empties into five wheelpits forming part of the power house substructure. In each of four of the wheelpits a 1,200 h.p. turbine is installed, of the double-runner, simple-discharge vertical type, direct connected to a 812.5 K.V.A., 3 phase, 60 cycle generator. In the fifth wheelpit an exciter turbine with vertical shaft is installed, driving a 85 K.W., 125 volt exciter. A second exciter is motor driven. The total capacity of the turbines is 4,800 h.p. under a head of 18 feet. Turbine regulation is obtained by automatic hydraulic governors. A spillway icerun is provided in a concrete wall separating the forebay from the Trent River. The power house substructure is of concrete and the superstructure of brick. A stony gate, operated by a travelling gantry, controls the openings to the wheelpits. A tailrace, 500 feet long, runs parallel with and is isolated from the river by a rock-filled crib faced with concrete on the river side and with timber on the tailrace side. Energy is transmitted to the transformer station of the Trenton development, about five miles south, at 6,600 volts, for distribution to the Central Ontario System.

SECTION NO. IV.

OTHER PROVINCIAL POWER COMMISSIONS.

The progress of the Power Commission of Ontario has been watched with keen interest in the other provinces of Canada, and Power Commissions have already been created in Manitoba, New Brunswick and Nova Scotia, while Prince Edward Island, though it possesses only small power sites, is included in the co-operative surveys of the two other Maritime Provinces now in progress.

MANITOBA.

In Manitoba an Act was passed in 1919 to provide for the transmission of electrical power under Government control, and this Act was amended in 1920. Executive powers are conferred on a single Commissioner, responsible to the Minister of Public Works. Under the Act any municipality, rural or urban, may, by resolution of Council, apply to the Minister for the supply of power for any purpose, the application being accompanied by statements showing the assessments, debts, rate of taxation, etc., and amount of power required. The Minister thereupon investigates the cost of the power and the financial position of the municipality, and if favorable to the proposition, gives an estimate of the cost of the transmission lines and the estimated price of the power, which shall cover fixed charges, maintenance, and replacement. Before a contract is made it must have the assent of the electors, by by-law passed by the municipality; and any loan raised by debenture must also have the endorsement of the electors and the approval of the Minister, as in the case of other loans raised for municipal purposes. The municipality shall appoint a superintendent to

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carry on the work, and he shall keep such records and accounting as may be prescribed by the Minister. In case of default, or threatened default, by the municipality, the Minister may appoint a receiver, and upon publication of official notice, dismiss the superintendent. In such cases the receiver appointed is directly responsible to the Minister, and all receipts and assets are at the disposal of the Minister or the Crown. The Minister may take the initiative for supplying power to any municipality which has not made application; or he may acquire an existing plant by purchase or lease, such plant to be carried on as a work under the Public Works Act, and the Minister having power to make contracts with individuals and charge such rates as may cover fixed charges, maintenance and replacement. The Minister has powers of expropriation, and without the consent of the Attorney-General no action may be brought against the Commission "or any of its Ministers for anything done or omitted in the exercise of its office," nor shall any liability be incurred by reason of error in estimates or plans furnished. The Commissioner is appointed by the Lieutenant-Governor in Council and holds office at the pleasure of the Minister.

The expenditures in Manitoba under this Act are now limited to a million dollars. Up to the present no water powers have been acquired by the Commission; but a contract has been made for a supply of power from the City of Winnipeg Hydro-Electric Power Plant, at a price to the Commission of one-half cent per kilowatt hour. This would average about \$16.50 per h.p. per year with a load factor of 50 per cent. As urban requirements average 60 to 70 per cent., this would make the average cost to towns and villages \$20.00 or less per h.p. per year. The cost to the municipalities will be this amount plus line losses, costs for operation and overhead expenses.

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The first application received by the Manitoba Power Commission was for power for Portage la Prairie, sixty miles west of Winnipeg. To this point a line has been built, having sufficient capacity to redistribute power to surrounding towns and rural municipalities, from a number of which applications have already been received.

The Commission is investigating the possibility of establishing fuel plants at various central stations, and as a beginning preparations are now under way for oil-burning plants at Virden and Minnedosa, and some preliminary studies have been made as to the economic possibilities of a water-power development at Stockton, on the Assiniboine River, where 1,000 h.p. may be developed.

NEW BRUNSWICK.

By an Order in Council passed in 1918, the "Water Power Commission of the Province of New Brunswick" was established, and this Commission, consisting of three members, C. O. Foss (Chairman), B. M. Hill, and W. E. McMullen (Secretary), made its first report in February, 1920. The Water Power Branch of the Department of the Interior at Ottawa had offered its help to New Brunswick and Nova Scotia in making a general survey of power sites, and, under this plan of co-operation, stream measurements have been going on. In 1919 Prince Edward Island joined the other two provinces in the investigations. The provinces and the federal department give one another the benefit of the information which each collects. The Commission is proceeding cautiously, the initial costs of development being an apparent difficulty, but competent engineers assure the Commissioners that there are several important sites, the available power of which will be marketed before the plants can be finished.

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To be organized to furnish the people with power under public ownership the "New Brunswick Electric Power Act" was passed by the Legislature at the session of 1920. This Act constitutes a Commission whose operation follows closely the lines of the Ontario Commission. The Commission will have wide powers, and the whole purpose of the Act is to facilitate the development of the unused water powers. Where they are now under private ownership, if the owners cannot, or will not, develop them, then the Commission may use its almost unlimited powers to purchase existing powers or expropriate the land, etc., and proceed to utilize power.

The Commissioners hold office during the pleasure of the Lieutenant-Governor in Council, which authority also nominates the Chairman, and fixes the salaries of the members. The Chief Engineer or other officer may be a member of the Commission. The Commission fixes the salaries and has control of its officers, subject to ratification of the Lieutenant-Governor in Council. The Commission is not limited to the use of water as a source of power, but may use coal, peat, gas or oil. It may, without the consent of the owner, enter upon and take lands on which a water power is situated; or may acquire a controlling interest in any corporation supplying electrical power, or may expropriate buildings or other property to carry out its work. The methods of expropriation and arbitration are set forth in the Act. If an owner does not agree with the Commission's offer as to value the matter is referred to the County Judge as arbitrator. On any dispute as to fact an appeal may be made to the Appeal Division of the Supreme Court, but no appeal is allowed beyond this hearing. Receipts and expenditures of the Commission are made through the Provincial Secretary-Treasurer, who will keep a special account for this purpose. An annual report will be made showing the operations of each system controlled by the Commission. The Lieutenant-

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Governor in Council may raise, for the purposes of the Commission, sums necessary not exceeding a total of one million dollars. Section 25 provides that "without the consent of the Attorney-General no action shall be brought against the Commission, or any member thereof for anything done or omitted in the exercise of his office," and neither the province nor Commission is liable for any errors in estimates, plans or specifications. Municipalities, rural or urban, may contract with the Commission for power; but such contract becomes binding by vote or resolution of the Council and does not require to be endorsed by vote of the electors, as in Ontario. One contracting municipality may supply a municipality which has no contract with the Commission, but not without the consent of the Council thereof. A municipality may carry on its work under the Provincial Commission either by a local Commission or by a manager. The price of power taken by the municipalities may be regulated and changed by the Commission, and the Commission does not appear to be limited to supplying power at cost.

The New Brunswick Commission has now been re-organized, the members being Hon. C. W. Robinson, of Moncton, Chairman; Mr. C. O. Foss, C.E., of St. John, and Mr. Reid McManus, of Moncton. Mr. W. E. McMullen remains the Secretary.

NOVA SCOTIA.

Nova Scotia was the first of the Maritime Provinces to undertake a survey of water powers on the co-operative plan already indicated. A "Nova Scotia Water Power Commission" was authorized in 1914, and made its first report in the following year. Four annual reports have been issued, the work of the Commission being confined to collecting data on the flow of streams, and the power possibilities of the various rivers. As

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stated in the first report of 1915, "the activities of the Hydro-Electric Power Commission of Ontario, as well as those of private concerns in other parts of the country, did not go unnoticed in Nova Scotia," and the Commission began to consider the problem of classifying the rivers for power and navigation purposes; and to frame rules for the expropriation of land and of riparian rights in order to establish power plants; and to reconcile the interests of agriculture, forest preservation and the industries with respect to the rights of property. These questions would arise very frequently here, because in time past more small water powers were used to operate saw mills, flour mills and carding mills in Nova Scotia than in any other part of Canada. It is said that the first mill on the continent to be driven by water was built by one of the Acadian French settlers as early as 1607, the ruins of this mill, at the mouth of the Lequille, being yet visible.

By an "Act respecting Water and Water-courses," passed in 1919, it was declared that notwithstanding any previous law or any grant or deed, all water and water-courses were henceforth vested in the Crown in the right of the province. However, where a person within two years of the passing of the Act establishes that he was lawfully using a water-course, he may be entitled to continue the use on terms deemed just by the Governor in Council.

In the same year an Act was passed constituting the "Nova Scotia Power Commission," composed of three members, which not only took over most of the work of the investigating Commission referred to, but has power to construct and operate power developments on a large scale. The new Commission is modeled after that of Ontario. It consists of three members, the Chairman being the Honourable E. H. Armstrong (Commissioner of Public Works and Mines); Frank C. Whitman, of Annapolis, and Robert H. MacKay, of New Glasgow. K. H.

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Smith, who had been Chief Engineer of the first Commission, becomes Chief Engineer and Secretary of the new Commission, while continuing to act for the Department of the Interior. Mr. Smith, in his reports, expresses his conviction that the foundations for water power development in Nova Scotia could not have been so well laid but for the co-operation of the federal and provincial departments.

The working relations between this Commission and the municipalities are much the same as in the case of New Brunswick, except that more authority, financial and executive, seems to be conferred on the Commission in Nova Scotia. A municipality may enter into a power contract with the commission without a special vote of the electors. An interesting provision is, that where a group of municipalities wish to become jointly responsible for a new power plant they may form a group and operate the plant as a "System." As is done in the other provinces, the Commission protects itself from vexatious legal actions by taking power to refuse a fiat.

This Commission has commenced its first power development at St. Margaret's Bay near Halifax and plans are being made for another in the Sheet Harbor District, Pictou County. Applications for power have also been made from other parts of the province and the Commission is actively investigating power sites in Lunenburg, Annapolis and Digby Counties.

SECTION V.—FINANCIAL SUMMARY.

The writer has endeavoured to spare the reader from digesting masses of statistics, but for the satisfaction of the student of the economic aspects of this history, a few figures summarizing the results to the end of 1919 will be instructive.

The plant owned by the Commission itself, and through which it serves all the municipalities with power and light, represents a cash value of \$56,923,000. This includes the value of the Ontario Power Co.'s works, now owned by the Commission. The plant owned by the constituent municipalities under the Commission is valued at \$24,298,870, making a total of \$81,221,870. The administration offices and the buildings for the various services described on other pages are worth in round figures \$1,000,000, but would cost over \$1,500,000 to replace under present conditions. The total cost of the Niagara power development, including construction related thereto, is \$15,000,000. To the above fixed assets will be added the value of material and supplies amounting to \$2,851,600; securities, interest bearing investments, sinking fund deposits, accounts receivable, and miscellaneous assets, with cash in the banks and on hand totalling about \$6,500,000, and making an aggregate, in round numbers, of \$106,600,000.

On the other side of the account there are current liabilities such as bills payable, etc., of \$1,910,500; cash advanced from time to time by the Provincial Treasurer, \$48,236,001; by the bank, \$1,200,000; bonds and debentures of the Commission, \$22,389,201; and bonds and debentures of the municipalities, \$18,133,462. To these are added the reserves, sinking fund debenture payments, \$3,781,642; renewals and contingencies, \$7,769,248. Allowing an ample amount for insurance reserves and doubtful accounts, there remains an unincumbered surplus of more than \$2,900,000 to the credit of the Commission at the end of 1919.

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